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ANTHROPOLOGY.—*Prehistoric culture waves from Asia to America.*[1]

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The recent excavations of Collins on St. Lawrence Island and at other places around the Bering Sea[2] seem to bring out one very important point, viz., that there has been no extensive migration across Bering Strait, unless it be of Eskimo, since the early centuries of the Christian Era. The Eskimo culture strata in that region show no profound disturbance such as one would expect from an invading horde, but rather a gradual change, stimulated to some extent by Asiatic as well as strictly American influences, but not by the intrusion of an alien people. Now Nordenskiöld and others[3] have proved that although a few Polynesians may on one or more occasions have reached the shores of America, there has never been any transoceanic migration large enough to affect profoundly the physical composition of the aborigines in the New World or the evolution of their cultures. We can rule out likewise any immigration by way of Kamchatka and the Aleutian Archipelago, if for no other reason than that the archipelago has yielded no traces of earlier remains than those of the Aleutian Eskimo, who undoubtedly reached their home from America. Bering Strait, therefore, was the only route of ingress into this hemisphere, and the forefathers of every known division of Indians must already have crossed this strait by the beginning of the Christian Era.

This conclusion harmonizes well with the results of linguistic studies. Hitherto we have utterly failed to link up any American Indian language with any language or group of languages in the Old

[1] Address of the retiring president of the American Anthropological Association, delivered at Chicago, Ill., on December 29, 1939.

[2] COLLINS, H. B. Archaeology of St. Lawrence Island, Smithsonian Misc. Coll. 96(1). 1937.

[3] Cf. NORDENSKIÖLD, E. Origin of the Indian civilizations in South America. Comparative Ethnographical Studies 9. 1931.
DIXON, ROLAND B. The long voyages of the Polynesians. Proc. Amer. Phil. Soc. 74(3): 167–175. 1934.

World. Thus Rivet's effort to connect the Hokan dialects of California with Malayo-Polynesian, and some Patagonian languages with Australian, has apparently found few supporters. Some day we may succeed in joining up Eskimo with the Ural-Altaic languages and in proving that the Athapaskan or Déné tongues of North America are genetically related to the Sinitic tongues of eastern Asia. Such relationships, however, even if confirmed, must be exceedingly distant, for we know how little the Greenlandic Eskimo dialects have diverged from the north Alaska ones, despite a separation of 1,000 years, and how small is the difference, after an equally long separation, between the Navaho Indian dialect in the Southwest of the United States and the dialects spoken in the Mackenzie River Basin. Probably much of the linguistic diversity among the Indians and Eskimo took place in Asia before their entry into the New World; but the fact that *no* American tongue is palpably related to any Asiatic one strongly suggests that the inhabitants of the New World, barring the Eskimo to whom I will return later, separated off completely from those of the Old more than 2,000 years ago.

On ethnological grounds, too, there seems no reason to question this conclusion, because the traits that are common to Asia and America, apart from a few that are concentrated near the bridge-head at Bering Strait, are so widely diffused in both continents that they evidently carry a very respectable antiquity. Even the resemblances between the Palae-Asiatics and the Indians of the northwest coast of America hardly demand a migration in post-Christian times. If there was such a migration it is more likely to have been from America to Asia by way of the Aleutians and Kamchatka, as Collins has shown,[4] than from Asia to America; moreover, it was a relatively insignificant migration that introduced into northeast Asia a few cultural traits such as labrets, certain forms of stone lamps, a certain type of house, and perhaps some folk tales, but failed to effect any far-reaching changes. It can hardly account for the much deeper resemblances, e.g., in physical type and clothing, between the Palae-Asiatics and some of the American Indians.

For the millennia that preceded the Christian Era, the millennia that saw the peopling and subsequent isolation of America, archeology, our safest guide, has afforded us hitherto only one or two uncertain clues. The main props for our theories have come from ethnology, linguistics, and physical anthropology, none of which can

[4] COLLINS, H. B., op. cit., pp. 375–378. Also Culture migrations and contacts in the Bering Sea region. Amer. Anthrop. 39(3): 375–384. 1937.

furnish more than the vaguest indications of a time sequence. In founding our theories on these disciplines we are building on shifting sand, and we need not be surprised if the theories topple over when the spades of the archeologists succeed in uncovering new and possibly unexpected remains.

The geographical position of the Athapaskan Indian tribes along the pathway from Bering Strait toward the Equator, the late date (about 1000 A.D.) when their advance columns reached the Southwest of the United States, the comparatively minor changes in their dialects from the Mackenzie Delta to Arizona, and the still demonstrable affinity of their language (if we may trust Sapir) to the Sinitic tongues of eastern Asia, all suggest that their movement into America did not long precede the Christian Era. There are faint indications that they may have entered this continent, or at least have advanced south from Alaska, in two waves, one considerably earlier than the other; for it is noticeable that the most divergent or archaic-seeming dialects (e.g., Haida and Tsetsaut) lie on the west side of the Rockies, where the snowshoe and the wooden toboggan so omnipresent in the Mackenzie River Basin seem to have been unknown in pre-European times. There are faint indications, also, that their irruption into the Mackenzie River Basin created a considerable displacement of other peoples who were occupying this region at the time, or were located on its outskirts.[5] A recent botanical investigation by Dr. Raup suggests that the grasslands of the Peace River area, perhaps too the forest zone along the northern edge of the plains, was muskeg land or tundra no longer ago than 2,000 or 3,000 years, and that the present-day bison and moose were preceded by herds of caribou. Presumably, the Eskimo of those days extended much farther south than they do now and were pushed eastward and northeastward by the invading Athapaskans. I incline to think that it was at this period the Caribou Eskimo were restricted to their present home on the Barren Lands west of Hudson Bay; and that a kindred group of Eskimo fugitives occupied the coasts of the eastern Arctic, where they developed that mysterious Dorset culture, which extended in prehistoric times from Newfoundland to Greenland.

In addition to driving out the Eskimo, the Athapaskans may have dislodged some Algonkian tribes, as Birket-Smith believes, and started them on a movement that carried them into the Labrador Peninsula. Certainly the traditions of these Montagnais and Naskapi

[5] Cf. BIRKET-SMITH, Kaj. Folk-wanderings and culture drifts in northern North America. Journ. Soc. Americanistes Paris, n.s., **22**: 26–29. 1930.

Indians bring them from the west, and the strange stone culture discovered by Strong near Nain,[6] on the Labrador coast, despite its distinctly Algonkian flavor, seems so alien to them that we may ascribe it tentatively perhaps to some early group that was later absorbed or destroyed by other Algonkians, as were the now-extinct Beothuk Indians of Newfoundland.

I am more reluctant to follow Birket-Smith in attributing to the Salish Indians of British Columbia an early home on the Canadian plains from which they were driven westward by the Athapaskans, because so many traits in Salish culture point to a southern rather than a plains' origin, and their language, even should it prove to be Algonkian, as Sapir suggests, differs so widely from Blackfoot, Cree, and other members of that linguistic stock that it surely indicates a very long separation. Nevertheless, we must not overlook the possibility that the Salish Indians may have a dual origin, that they may be an amalgamation of two groups, one of which came originally from the south, and the other from the Canadian plains.

Shapiro and Seltzer[7] have pointed out the marked resemblance in physical type between the northeastern Algonkians (including the Hurons, who absorbed many Algonkians into their ranks), the Chipewyan Indians of Lake Athabasca, and large groups of Arctic Eskimo, particularly those in Coronation Gulf, Smith Sound, and Seward Peninsula. Now we know that at least the Coronation Gulf Eskimo, like those of Hudson Bay, dwelt inland only a few centuries ago. Hence physical anthropology also seems to indicate that the Eskimo and Algonkians formerly lived in such close contact, somewhere in the heart of Canada, that either the Eskimo freely took Algonkian wives or certain Algonkian groups adopted the Eskimo culture, and, under pressure from the invading Athapaskans, moved northward to the Arctic coast.

It is idle to speculate on the Asiatic home of the Athapaskans or the route they followed to Bering Strait. Even archeology may never be able to throw light on this question, because the majority of their tools and weapons had blades and points of bone rather than of stone, and bone disintegrates very rapidly. This, at least, is true of Canada. In Alaska there seems to be a greater wealth of stone implements,

[6] STRONG, W. D. A stone culture from northern Labrador and its relation to the Eskimo-like cultures of the northeast. Amer. Anthrop. 32: 126–144. 1934. Cf. the review by WINTEMBERG, W. J., in Geogr. Rev., Oct., 1930, p. 673.

[7] SHAPIRO, H. L. The Alaskan Eskimo. Anthrop. Pap. Amer. Mus. Nat. Hist. 31(pt. 6). 1931; The origin of the Eskimo. Proc. 5th Pacific Sci. Congr. 4: 2723–2732. 1933.

SELTZER, CARL C. The anthropometry of the western and copper Eskimos. Human Biol. 5(3): 312–370. 1933.

and there too we find pottery as far up the Yukon River as the mouth of the Tanana. Both these traits, however, may well be due to Eskimo influence, since no other American Athapaskan tribe was acquainted with pottery unless it bordered on a pottery-using people.

We may assume, then, until evidence to the contrary is forthcoming, that hordes of Athapaskan-speaking peoples crossed Bering Strait some time in the first millennium B.C. and forced their way southward, some by way of the Mackenzie River, others down the western slopes of the Rockies until they reached Colorado, Arizona, and New Mexico. It was they, perhaps, who introduced bows and arrows and the Mongoloid strain in Pueblo I remains, shortly before the end of the first millennium A.D.; they, too, who introduced the snowshoe and other important elements into America, as Birket-Smith cogently argues—though I find it difficult to ascribe to an Athapaskan invasion all the elements he includes in the snowshoe complex, particularly hunting territories, which I suspect are post-European, and moccasins, cradle-boards, bark vessels, and the use of fatty substances for tanning skins, since these elements occur also in the extreme south of South America.

Inseparably linked with the Athapaskan invasion are the Eskimo, whom they partly dislodged, and the Indians of the northwest Pacific coast, the "totem-pole" Indians whose origin and culture still remain a profound mystery.

Let us consider the latter first. Smith's excavations in the shell-heaps along this Pacific coast have yielded rather negative results, although the forest growth proves that some of the heaps were abandoned at least 500 years ago and that their lowest levels must be several hundred years older. They revealed that there was a long-headed strain in the population that is absent in the modern Indians of the region; also that a few implements had a somewhat restricted range, being absent either in the more northern heaps, or in the more southern. By and large, however, there was little or no indication of any earlier culture than that which was still flourishing along this coast in the nineteenth century, although it was originally somewhat simpler, and more nearly related, apparently, to that found inland up the Fraser River. Even in the first millennium A.D., then, it was apparently well rooted in its present home.

As far as their physical type is concerned, the modern Indians of this area are indistinguishable, Hrdlička states, from the Gilyak and other tribes on the Amur River in Siberia; but the affinities of the earlier, long-headed strain are uncertain.

Linguistic studies indicate that Haida and Tlinkit are greatly modified forms of Athapaskan or Déné, that Tsimshian is a Penutian tongue related to some languages in California, while the three southern languages, Kwakiutl, Nootka, and Salish, may ultimately prove to belong to the Algonkian linguistic stock. This helps our present enquiry very little, except that it suggests a pressure of Athapaskan tribes in the north strong enough to impose the language but not to alter the physical type; and since the Haida and Tlinkit languages are so unlike each other, and so unlike other Déné tongues, it suggests also that they originate from the earliest Athapaskan wave and have undergone considerable changes since, partly owing to their isolation and partly to the influence of neighboring tongues.

The evidence of ethnology is rather confusing. Several traits, notably weaving with loom and spindle, the sib and moiety system, and the chewing of "tobacco" with lime, suggest a linkage with the south and middle America. Others may have developed locally, e.g., plank houses, special types of twined basketry, the caste stratification, and the peculiar style of art. A few traits lead us northward; thus the whaling practices of the Nootka, and the decorated lamplike vessels of stone that were made by the Coast Salish, find their nearest if not their only parallels among the Eskimo. Several traits, however, carry us beyond the Eskimo right into Asia. There is slat armor, distributed almost continuously through Bering Strait (where it was used in the first millennium A.D.) to Japan and China; woven hats, a definitely Asiatic trait; curved fish knives, which recall East Asiatic curved knives as well as the Eskimo *ulo;* a musical style that seems altogether different from that of other American Indians, but, according to Barbeau,[8] so strongly Asiatic that certain songs practically coincide with northeastern Siberian ones, while others closely resemble Chinese Buddhist chants; and a social organization based on wealth rather than on descent or prowess as elsewhere in America, an organization that expressed itself outwardly in a potlatch system strongly reminiscent of Indonesia and Melanesia, and in totem poles and grave monuments that, despite profound differences, instinctively draw our eyes to the grave posts on the Amur River. Even the unique art of this northwest coast may offer a clue, because, as Collins[9] has pointed out, its eye designs resemble those of the mysterious Old Bering Sea Eskimo and also the eye designs on Chinese Shang Dynasty bronzes of the second millennium B.C. Finally, we have such

[8] BARBEAU, MARIUS. The Siberian origin of our north-western Indians. Proc. 5th Pacific Sci. Congr. 4: 2781–2784. 1933.

[9] COLLINS, H. B. Op. cit., p. 298.

close parallels in mythology between the northwest Indians and the Palae-Asiatic tribes of Siberia that Jochelson went so far as to postulate a backward movement of tribes from America into northeastern Asia.

We might also add in this connection two other elements not found on the Pacific coast itself but present among the Interior Salish Indians of the Fraser River Basin. One is the torpedo-shaped bark canoe, known elsewhere only from the Amur River in Siberia. The other is the semiunderground house, distributed all round the north Pacific basin from China to the Southwest of the United States but in so many forms that the genetic relationship of them all is still uncertain.

We do not know, of course, the relative ages of all these traits common to Asia and the northwest coast of America. Some may be comparatively modern, others very old. Some may have spread by slow diffusion, just as tubular pipes and the tobacco *Nicotiana attenuata* spread northward and reached the Fraser River only a short time before European occupation; others, again, may have been carried by a mass migration. Two or three of them, however, notably the social organization based on wealth, the talent for sculpture, and the music (if this is confirmed) appear so deeply seated that almost involuntarily we associate them with some invading people, a people whose original home lay somewhere, perhaps, around the Amur River. Yet whether such an invasion ever did take place, and, if so, whether it preceded or followed the Athapaskan invasion, must remain unsettled until we know more of the archeology of the north Pacific coast of America and also of northeastern Asia.

Archeology has made more progress with the Eskimo, the other people who appear to have been influenced by the Athapaskan invasion. Here I should like to pay tribute to the magnificent work of Danish scholars, not only the brilliant galaxy still living but to the long line of their predecessors, from Hans Egede in the eighteenth century, Henry Rink in the nineteenth, to the last and in some respects the greatest of them, the late Knud Rasmussen. Thanks largely to Danish researches, supplemented by those of the Smithsonian Institution in Washington, we know that behind the modern Eskimo cultures there are three ancient ones, the Old Bering Sea in the west, the Thule, which originated in the west but spread over Arctic America to Greenland, and the Dorset, which was restricted to the eastern Arctic. The origins of all three cultures still await the results of further excavations in both the east and the west. Tentatively, however, I

should advance the following hypotheses, in the hope that they may stimulate and guide the workers of the future.

In spite of suggestions to the contrary, I still believe that the third culture, the Dorset, is a genuine Eskimo one that has absorbed certain Indian traits, rather than an Indian culture that has Eskimoized itself, for the reason that we know of no Eskimo culture except the Thule that could have influenced it, and many of its non-Indian traits are equally non-Thule. Of special significance is the fact that a few of these traits seem to hark back to a very early Eskimo stage, because we have no parallels to them except in the far west. Collins[10] has already pointed out that in the Dorset, as in the ancient Aleutian and Old Bering Sea cultures of western Alaska, chipped stone implements immeasurably outnumber those implements of polished slate that are so characteristic of Thule and later times; also that Dorset art represents a fairly close approach to Old Bering Sea style I.

Let us examine these early eastern and western cultures more closely. In both the Dorset and the Old Bering Sea, but not in later remains, we find incurved side scrapers and trapezoidal knives of chipped chert, small slate implements with rubbed edges[11] that may have been boot creasers, and rubbing stones of polished crystalline rock, quartz in the east and basalt in the west. From an Aleutian shell-heap, again, Hrdlička has brought back such typical Dorset types as small leaf-shaped blades notched on each side of the base, knives with curving edges like miniature hunting-knives, and points with concave bases, the only difference being that the Aleutian specimens are chipped from crude basalt instead of the more amenable chert and quartz. One Aleutian knife (?) even has three notches on each side of the base, as we find on a few Dorset specimens also.[12]

Now we must not forget that in addition to these special forms known only from the east and the far west, the Dorset culture possesses many other old Eskimo traits, such as toggle harpoon heads, eyed needles and tubular needle cases, chipped end-scrapers, polished stone adz heads and adzlike scrapers, barbed bone fish-spear points, stone lamps and pots, and even "jumping stones."[13] It is true that some of these objects have peculiar shapes, but there are others hardly

[10] COLLINS, H. B. Op. cit., p. 373.

[11] In the Dorset culture implements of both slate and chert.

[12] At Kachemak Bay de Laguna found the following Dorset types: planing adz blade, chipped asymmetric knife blade with notched tang, one type of harpoon head, needle, and dart heads barbed symmetrically and asymmetrically on both sides. (FREDERICA DE LAGUNA, Archaeology of Cook Inlet, Alaska, p. 213, 1934.)

[13] "Jumping stones" have been discovered in Newfoundland and, more recently, inland from Hudson Bay, in the territory of the Caribou Eskimo.

distinguishable from Eskimo types elsewhere. Furthermore, the Dorset people possessed in full measure the skill of other Eskimo in carving bone and ivory, for in 1937 Rowley brought back from Iglulik, on the northwest coast of Hudson Bay, some excellent figurines of Dorset manufacture that rival in workmanship similar figurines from any period of Eskimo history.

In view of all this, are we not justified in suspecting, not merely that the Dorset culture is genuinely Eskimo, but that it has stemmed from the same parent trunk as the ancient cultures of western Alaska?

If we accept this reasoning, then we must believe that the ancestors of the Dorset people separated from the western Eskimo before the flowering of the Old Bering Sea culture about the beginning of the Christian Era. This would date their entry into Canada not later than the first millennium B.C., and possibly even in the second millennium. The closing centuries of the second millennium B.C. appear in fact the more probable if, as I have already suggested, it was an invasion of Athapaskan tribes that pushed the Dorset people out to the coast of the eastern Arctic; for the Athapaskans themselves, as we have seen, must have crossed Bering Strait from Asia before the Christian Era.

Collins[14] has already pointed out certain features in which the Dorset Eskimo influenced later cultures in the eastern Canadian Arctic and in Greenland. He has shown that the modern form of the eastern harpoon head, with its bifurcated base and line holes on the upper surface, is probably derived from a Dorset type; also that Solberg's Stone Age culture in northwest Greenland represents a mixture of Dorset and Thule elements. Even the physical characteristics of the Greenland Eskimo may have been modified by Dorset admixture, since Greenland Eskimo skulls (outside of Smith Sound) resemble those of the old Birnirk Eskimo in the western Arctic (who were the immediate successors, if not the actual contemporaries of the Old Bering Sea people), more than they do Thule skulls from the eastern Arctic, or the skulls of Thule descendants in Smith Sound, Southampton Island, and Barrow.[15]

Let us turn our eyes again to the western Arctic, where Collins has so brilliantly deciphered the Old Bering Sea culture and traced its evolution, or devolution, down to modern times. The Birnirk

[14] COLLINS, H. B. Op. cit., pp. 315, 336.

[15] Cf. FISCHER-MØLLER, K. Skeletal remains of the central Eskimos. Rep. 5th Thule Exped. 3(1). 1937; and Skeletons from ancient Greenland graves. Medd. Grønland 119(4). 1938.

phase of Barrow appears in his sequence as the immediate successor of the Old Bering Sea, marking the beginning of the Punuk culture. It seems rather strange, however, that its characteristic harpoon heads are made of bone instead of the usual ivory, and that they are rarely if ever decorated. Like the later Thule-type harpoon heads also present on St. Lawrence Island, they rest there uneasily as if they were intruders and did not belong to the strict order of succession, Old Bering Sea, Punuk, and modern. One wonders, too, why the Old Bering Sea art should have undergone a slow and gradual modification on St. Lawrence Island all through Punuk times, century after century, whereas at Barrow it vanished completely in the Birnirk stage.

Can it be that the St. Lawrence material is slightly misleading? The Birnirk (and its first-born child the Thule) is perhaps *not* a direct offspring of the Old Bering Sea, but both may be offspring of some less advanced culture that flourished on the northeast coast of Siberia around the mouths of the Kolyma and Indigirka Rivers. From this region the hypothetical parent culture may have sent its offspring eastward. One branch crossed over Bering Strait and proceeded north along the Alaskan coast to Barrow, blazing a trail that was followed by trading parties in later centuries; it still maintained connections with the south, however, since Geist[16] found a whetstone of Kobuk River nephrite in Old Bering Sea remains on St. Lawrence Island. The other branch colonized the coastline of Siberia southward from East Cape and either then or later established a few outposts on St. Lawrence Island. Subsequently, I suspect, the southern colony on the Siberian shore below Bering Strait, powerfully stimulated by a yet more southern source (ultimately, it may be, from China), revolutionized its style of art, and acquired perhaps some new elements, such as pottery and the bow drill, that appear to have been unknown in the still earlier period I hinted at before, the period when the ancestors of the Dorset people first crossed Bering Strait onto Alaskan soil and pushed into the heart of North America.

The reader may say, perhaps, that, like a fecund rabbit, I have already delivered too large a brood of unsubstantiated theories (some of them possibly still-born). Nevertheless I hope he will pardon me if I add one more progeny to the overabundant litter.

In Old Bering Sea remains on St. Lawrence Island Collins found many dog skulls that had been broken for their brains; and the dogs

[16] GEIST and RAINEY. Archaeological excavations at Kukulik, St. Lawrence Island, Alaska. Misc. Publ. Univ. Alaska 2: 190. 1936.

were of a smaller breed than those of Punuk and later times. Furthermore, objects associated with dog traction, such as toggles, flat bone sled-shoes, and whip ferrules, did not appear until the close of the Punuk period, or roughly 200 years ago, so that evidently the St. Lawrence islanders throughout most of their history never used dogs to drag their heavy-runner sleds. In the eastern Arctic, however, Mathiassen found numerous dog-harness toggles in Thule remains dating back 1,000 years or so; and the dogs that wore this harness doubtless belonged to that rather large and heavy breed so prevalent in the eastern Arctic today. Moreover, the Thule Eskimo, like the modern, seldom or never ate them, for Mathiassen remarked no broken dog skulls in any Thule site. No dog bones have yet been recovered from an unmixed Dorset site, nor have we found any sled toggles or harness toggles, though there are some flat, bone sled-runners. We read in Frobisher's Voyages,[17] however, that in the sixteenth century the Eskimo of Frobisher Bay, in the heart of the old Dorset range at the eastern entrance to Hudson Strait, kept two distinct breeds of dogs, a smaller one for eating and a larger one for dragging the sleds.

How are we to explain these facts? It seems to me quite possible that dog traction was unknown to the earliest Eskimo who reached America, not only to those who remained in Alaska, but to those too who pushed eastward into Canada and later spawned the Dorset people, and perhaps also the modern Caribou Eskimo. Both groups alike, however, kept a small breed of dog for hunting and for eating. Then, about the end of the Birnirk phase at Barrow, some time in the first millennium A.D., a larger, sturdier breed of dog was introduced into Arctic America from Siberia, where dog traction, if not earlier than reindeer traction, arose as a substitute. About the same time, too, whaling originated in the same region or was introduced from Siberia also. Under the combined impulses of dog traction and whaling certain bands of these north Alaskan Eskimo trekked eastward, carrying their Thule culture with them; and in the eastern Arctic they encountered and merged with the Dorset people. Dog traction then became general throughout the whole of the Arctic, though St. Lawrence Island, being in a kind of back eddy, did not receive it until rather late. The smaller breed of dog in the west and east became extinct, but in Frobisher Bay a mixed group of Thule and Dorset Eskimo retained and ate it down to the sixteenth century, when it disappeared there also.

[17] The three voyages of Martin Frobisher, pp. 136–137. Hakluyt Society, London, 1876.

You will note that I have pictured the original homeland of the Eskimo, not in America, but in northeast Siberia about the mouths of the Kolyma and Indigirka Rivers. It would not surprise me if it were in this region, rather than in northern Alaska, that the Birnirk culture evolved, and even the subsequent Thule. Yet it is probable that the homeland as thus defined is far too narrow, that it should be extended westward. Certainly in post-Christian times there were Eskimo-like people far to the westward, on the Yamal Peninsula, for example, at the mouth of the Ob, where Chernezov has excavated three of their earth lodges,[18] probably also in northeast Russia, since the kayak and bidarka are reported from that region as late as the sixteenth century.[19] If some antecedent to the Old Bering Sea, Birnirk and Dorset cultures could be discovered on the Arctic coast of western Siberia, it would vastly lessen the gap, both in time and space, between the historic Eskimo cultures and those of the epipalaeolithic peoples of northern Europe to which they bear a considerable resemblance.

In expounding his fertile theory of two culture layers in northern Eurasia and North America, an earlier coastal or ice-hunting layer and a later inland or snowshoe layer, Hatt justly signaled out the Eskimo as belated survivors of the ice-hunting stage who had adapted themselves to life on the seashore and to the hunting of sea mammals. If, as I have attempted to show, this adaptation occurred on the Arctic coast of Siberia, not later than the second millennium B.C. and probably much earlier, than we should look for its inland predecessor in that "Siberian pocket" of which Zolotarev speaks, the Barstinsky Steppes, the upper Irtish, Ob, and Yenesei regions, and the narrow strip of territory extending to Yakutsk. Quite probably it will prove to be but one of many cultures, closely alike, that extended during epipalaeolithic and early neolithic times from the Baltic to eastern Siberia. The snowshoe may have originated on the southern fringe of this zone, perhaps near the Lake Baikal region. At all events, the complex to which it gave rise seems to have contributed very little to the Eskimo cultures until relatively recent times, if we disregard the pressure exerted by its American carriers, the invading Athapaskans, on the Eskimo of eastern Canada. As far as we know today, the snowshoe itself first appears among the Eskimo in the Thule-age mound-dwellings at Wales, Alaska, which may not be older than six or eight centuries.

[18] Cf. ZOLOTAREV, A. The ancient culture of north Asia. Amer. Anthrop. 40: 15. 1938.

[19] Cf. MACRITCHIE, D. Journ. Roy. Anthrop. Inst. 42: 493–510. 1912.

I have suggested that pottery, being unknown to the Dorset people, reached Bering Strait after some of the Eskimo had already entered America and wandered eastward. Richthofen[20] has drawn attention to the striking resemblances, particularly in decoration, between pottery found at Krasnojarsk and other places in Siberia, and pottery from the Algonkian or Woodland area in eastern Canada and the northeast United States. Following up this observation, McKern[21] suggests that "a culture closely related and directly parent to the Woodland Pattern, with pottery but without agriculture, originated in Asia, came into America and inland by way of the Yukon and Mackenzie Valleys, had a special development in a locale centering just south of Lake Superior to become what is now classified as the Woodland pattern, and diffused from that center west, south and east to its maximum area limits, which are not as yet well defined."

There are serious objections to this hypothesis. In the first place we have no evidence that any of the pottery found in this section of North America dates back beyond the Christian Era, and in more than one place, e.g., at Lamoka, we have discovered the remains of an earlier people who, like the Newfoundland Beothuk, did not use pottery. Secondly, not a single sherd of pottery is known from the Mackenzie River Basin or the upper reaches of the Yukon; and the pottery on the lower Yukon was probably copied from the Eskimo of the Punuk period. We have every reason to believe that no Athapaskan tribe ever made pottery unless, like the Sarcee, it was in close contact with a pottery-using people. It is true that we have found sherds at a few sites along the southeastern fringe of the Mackenzie Basin—at Isle à la Crosse, Reindeer Lake, and Cree Lake—but only within the range of Cree penetration, and the sherds themselves resemble Woodland pottery from eastern Canada. In view of the vast potteryless gap separating this Woodland area from the Alaskan Eskimo, and the comparative lateness of pottery, apparently, in the Woodland area itself, it would seem more reasonable to believe that the latter acquired the idea of making pottery from the pottery-making peoples bordering them on the south than to connect them with the Krasnojarsk and other Siberian cultures so far removed in space, if not also in time. As long as the highway from Asia to America—that is to say, all Alaska outside the Eskimo area, and the

[20] RICHTHOFEN, B. FRHR. V. Zur Frage der archäeologischen Beziehungen zwischen Nordamerika und Nordasien. Anthropos 27: 123–151. 1932.

[21] MCKERN, W. C. An hypothesis for the Asiatic origin of the Woodland culture pattern. Amer. Antiquity 3: 138–143. 1937. Cf. also FEWKES, V. J. Aboriginal potsherds from Red River, Manitoba. Ibid.: 143–155.

whole of northern and western Canada—yield no sherds, we should cling to the theory that American pottery evolved quite independently of pottery in the Old World.

Beyond the second millennium B.C. we enter a realm of twilight, where ethnology almost ceases to flicker and archeology provides only one or two faint gleams to light our path. From the Gobi Desert in Mongolia, where Nelson[22] discovered a preneolithic microlithic culture of Azilio-Tardenoisian character, and Afontova on the Yenesei, where Von Merhart[23] suspects a microlithic station, we jump to the Amur River, whence other microliths are reported,[24] and from there to Fairbanks, Alaska, where microliths unearthed on the university campus seem to Nelson identical with his Mongolian finds.[25] Can it be that these mark a culture movement from Asia into America, and not merely a culture movement, but a movement of peoples?

Still more recently, and from Fairbanks also, it is reported that a stone spearhead resembling a Yuma type was found embedded in a small mastodon.[26] Now Yuma points are closely related to the Folsom complex, the oldest yet known in America, dating from a period when the camel, the mammoth, the mastodon, and other animals now extinct were still comparatively abundant. Because we have hitherto discovered no trace of this complex outside of the United States and the Canadian prairies, certain writers have suggested that it is a purely North American development. As Nelson[27] points out, however, we must continue to assume that its ancestry lies in the Old World until we find in North America a still older and more primitive industry from which it can be derived. This Yuma-like spearhead at Fairbanks should encourage us to search for the complex farther north and west, right into Asia itself.

The Fairbanks discoveries are intriguing from another standpoint. They appear to disclose one of the stations on man's journey from the Old to the New World, thereby enabling us to map out his route. Many Eskimo have journeyed from Bering Strait round the Arctic coast of Alaska to the Mackenzie River Delta, following a route that was probably open in early postglacial times also. It may, indeed,

[22] BERKEY, C. P., and NELSON, N. C. Geology and prehistoric archaeology of the Gobi Desert. Amer. Mus. Nov., no. 222. 1926.
[23] VON MERHART, GERO. The palaeolithic period in Siberia: Contributions to the prehistory of the Yenisei region. Amer. Anthrop. 25: 45–46. 1923.
[24] Sovietskaya Archaeologiya, no. 1, quoted in Antiquity, Dec. 1937, p. 497.
[25] NELSON, N. C. Notes on cultural relations between Asia and America. Amer. Antiquity 2: 267–272. 1937.
[26] Amer. Antiquity 3: 188. 1937.
[27] NELSON, N. C. Amer. Antiquity 2: 320. 1937.

have been easier at that period than today, for the climate was perhaps milder and the Mackenzie Delta not quite so far north. The discoveries at Fairbanks seem to indicate, however, that some at least of the early migrants passed up the Yukon Valley, crossed to the eastern side of the Rockies (probably over the low divide at the headwaters of the Liard River), and traveled down the eastern foothills of the mountains into the United States. Some of the later migrants may have traveled down the western side of the Rockies also, but in early postglacial times this route was probably blocked by ice.

BOTANY.—*Two new North American species of* Vitis.[1] J. L. FENNELL, U. S. Plant Introduction Garden, Coconut Grove, Fla. (Communicated by S. F. BLAKE.)

This paper includes descriptions of a new grape of the *aestivalis* series from Florida and of another of the *rotundifolia* group from Mexico. The latter is of especial interest as the first member of the section *Muscadinia* found in the tropics.

Vitis gigas Fennell, sp. nov. Fig. 1

FLORIDA BLUE GRAPE

Rami saepius glandulari-spinulosi, innovationibus dense albido- vel ferrugineo-tomentosis; folia magna saepius 3–5-lobata inaequilateralia, lobis acutis vel acuminatis; thyrsi fructiferi plerumque ramosi conici; baccae nigrae glaucae 10–14 mm diam.; semen ca. 6 mm longum 4 mm latum pallide olivaceum, raphi canalem apice seminis paene explente, rostro et chalaza obscure aurantiacis.

Series Aestivales. Vigorous high-climbing and heavy-foliaged vine with large leaves and strong heavy canes; internodes medium to long, mostly beset with few to many glandular prickles on strong growths; young wood green or reddish, mostly with some pruinose bloom near nodes, but this often obscured by the rusty wool; canes terete, finely striate, mostly retaining gray tomentum and black prickles into winter, then of a dark buckeye color; diaphragm of full-sized dry canes typically about 3 mm thick; tendrils intermittent, strong, often trifid, brown-woolly; growing tips and young leaves covered with a dense white or cream or even rusty-colored feltlike tomentum which mostly becomes rusty-floccose a foot or so back from tip. Petioles slender, medium to long, usually 6–8 cm, often retaining loose wool, round or sometimes shallowly grooved above; leaves large, commonly 6–7 inches long from tip of apex to tip of basal lobe, by 5–6 inches broad, often larger, rusty, tan or gray-tomentose beneath; generally ovate, mostly sharp-shouldered, but often 3- or sometimes 5-lobed, and then often unequilateral; margin irregularly, sometimes deeply sinuate-toothed with most of the principal veins ending in a slender cusplike point; basal sinus broadly to narrowly U-shaped; apex of leaf acute and mostly long-tapering; shoulder points mostly acute and often long-acuminate, occasionally

[1] Received September 15, 1939.

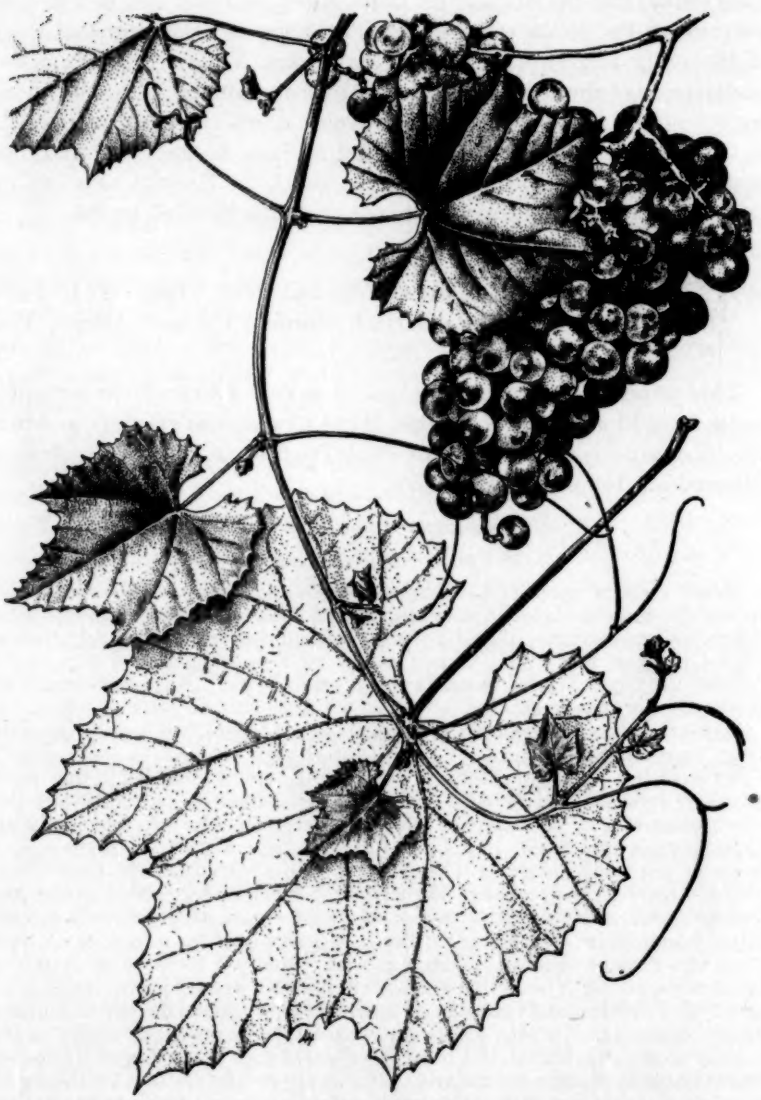

Fig. 1.—*Vitis gigas*, ×½.

rounded and then mostly short-acuminate-tipped. Inflorescences 11–19 cm long, conical to broadly so, mostly well compounded; peduncle slender and moderately long, often with false tendril; pedicel slender and long, giving cluster a somewhat lax appearance, at insertion of berry green and but little warty. Berry spherical to slightly oblate, 10–14 mm, black, with medium to heavy bloom, mostly blue in appearance when ripe; pulp greenish. Seeds plump, 6 mm long by 4 mm broad, pale olive or tan in color due to the tan-colored scurf which holds tightly to the coffee-colored testa; chalaza round to ovate, little sunken, and like the beak, of a dull orange color; raphe and chalaza surrounded by a tiny groove on outer face; ventral depressions pale tan in color, shallow, curving away from raphe toward top.

FLORIDA: Sebastian River, near Roseland, Brevard County, July 20, 1938, *J. L. Fennell* 713 (type nos. 52252–52253, National Arboretum Herbarium).

From present knowledge *Vitis gigas* apparently has a very limited range, though in colonies where found it constitutes the typical and abundant representative of the Aestivalian series. In a few cases it takes close observation to distinguish by the foliage alone the Florida blue grape from some of the natural hybrids of *V. shuttleworthii* or of *V. simpsoni* (*V. cinerea floridana*). However, the spinulose pubescence of the internodes, the blue bloom of the shoots and fruit, the much larger leaves, the green pulp of the berries, and the different seeds are distinctive.

In a few respects, such as shape of leaf, *Vitis gigas* is suggestive of some of the midway forms of *V. aestivalis* and *V. argentifolia* as seen in Virginia or Kentucky. The great vigor and rampant growth of the Florida species, however, as well as the different soil and climatic associations and its botanical peculiarities, set the Florida blue grape apart as a distinct kind.

The species is characteristically found forming heavy canopies of foliage over trees along the dry shelly banks of brackish waterways and lagoons. Together with the rampant *Dalbergia ecastaphyllum*, it often forms almost smothering mantles of growth that extend from the water's edge to the tops of the highest jungle trees. I have often seen half-grown boys clamber up over these strong tangles of vines from the water to the very topmost branches of the trees 50 feet or so above the river.

Vitis gigas is found mostly in sweet soil having a high shell content.

Vitis popenoei Fennell, sp. nov. Fig. 2

"TOTOLOCHE" GRAPE; SOUTH MEXICAN MUSCADINE GRAPE

Cortex adhaerens lenticellatus non fissilis; medulla nodis non interrupta; cirrhi interrupti simplices; folia serrata glabrata longiora quam latiora longe attenuata, in petiolis pubescentibus supra sulcatis; semen reticulatum in facie exteriore e rostro ad apicem sulcatum.

Subgenus *Muscadinia*. Slender vine with tight, lenticellate, nonshredding bark; pith of canes continuous; matured first year canes olive-brown in color, lucid, sometimes finely puberulent especially near nodes, often somewhat swollen above nodes; tendrils intermittent, simple, glabrous except near base; young growth somewhat angled or squared. Mature leaves small to medium, usually cordate-ovate with slenderly acuminate apex, not broader

than long (from insertion of petiole to apex), thin, rugose, lucid, glabrous on both sides except for some pubescence on the nerves beneath, moderately to coarsely serrate and often finely ciliate, the sinus narrowly to broadly V-shaped, the under surface occasionally somewhat reddish, the shoulder points sometimes prominent; lateral veins (not including the subbasal veins) 3 or 4 pairs; petioles slender, moderately long, grooved above, finely and

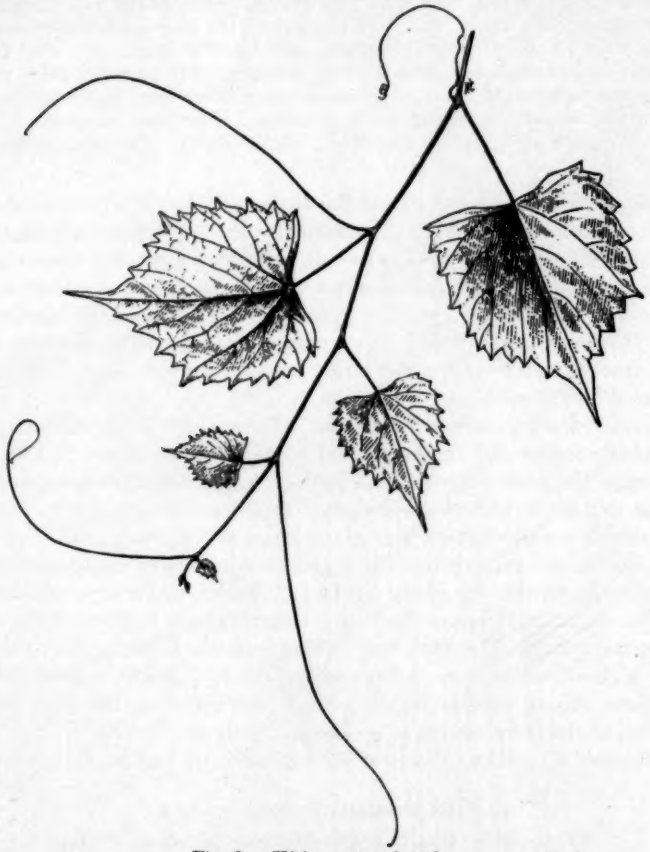

Fig. 2.—*Vitis popenoei*, ×½.

closely puberulent. Fruiting panicle not seen (said to be of small to medium size); berry not seen (said to be about one-half inch in diameter, maroon red to purple in color; skin thick; pulp green; ripe fruit has musky aroma [Popenoe's notes]). Seeds mostly about 5.5–6 mm long, about 4 mm broad, ovoid to nearly oblong, often unequally developed; beak short; groove extending from beak to top of seed on outer face; chalaza elliptical to sometimes nearly round; raphe evident only on inner face of seed and then as narrow thread; color of seed very dark and surface when dry reticulate-wrinkled.

MEXICO: Grown at Coconut Grove, Fla., from seed collected by Wilson Popenoe (P.I. 119001) at Puerto Mexico, Isthmus of Tehuantepec, Veracruz, Mexico. Type no. 56266, National Arboretum Herbarium, collected July 5, 1939, by J. L. Fennell (no. 1008).

In general appearance *Vitis popenoei* is somewhat more suggestive of *V. rotundifolia* than of *V. munsoniana* owing to the mostly smaller-toothed leaf margins and the thin, rugose leaf texture. It is at once distinguished from either of these species, however, by the relatively longer leaves and by the slenderly prolonged leaf apex. In this respect the foliage is somewhat suggestive of that found on certain forms of *V. cordifolia*. Average leaves of both *V. rotundifolia* and *V. munsoniana* measure broader than long (from insertion of petiole to apex) in distinct contrast with those of *V. popenoei*, which are mostly not broader than long.

In addition to its botanical differences *V. popenoei* occupies a distinct climate and a range several hundred miles farther south than that occupied by either of the other two known species of *Muscadinia*. It is the first and only muscadine grape yet known to occur naturally within the tropics. A study of its genetic relationship as regards the other muscadine and Euvitis species might bring to light certain characters of horticultural or botanical interest.

BOTANY.—*Two new species of* Muhlenbergia.[1] CHARLOTTE O. GOODDING, Rocky Mountain Herbarium, Laramie, Wyo. (Communicated by JASON R. SWALLEN.)

Recent study of the genus *Muhlenbergia* has revealed the presence of two new species, both of which occur in the canyons of southern Arizona.

Muhlenbergia xerophila C. O. Goodding, sp. nov.

Perennis; culmi dense caespitosi, glabri vel scaberuli, 45–90 cm alti; ligula obtusa, 1.5–3 mm longa; laminae involutae, 15–50 cm longae, 1–1.5 mm latae; panicula pallida, 15–35 cm longa; glumae 2–3 mm longae, acutae vel acuminatae, scabrae ad apex; lemma 4 mm longum, scabrum; callum hirsutum; arista 18–25 mm longa.

Plants perennial; culms densely caespitose, glabrous to very slightly scabrous especially below the nodes, 45–90 cm tall or sometimes more; sheaths rounded, very slightly scaberulous; ligule membranaceous, 2–4 mm long, obtuse; blades involute, 1–1.5 mm wide, 15–50 cm long; panicle open, 15–35 cm long about 4–5 cm wide, pale, the branches up to 7 cm long, filiform, flexuous; spikelets about 4 mm long; glumes equal to slightly unequal 2–2.5 or even 3 mm long, 1-nerved, acute to acuminate, the apex scabrous to very short pubescent; lemma about 4 mm long, scabrous above with short tufts of hairs on the callus, 3-nerved, the midnerve extending into a slender awn 10–35 mm long.

[1] Contributions from the Department of Botany and the Rocky Mountain Herbarium of the University of Wyoming, Laramie, Wyo., no. 175. Received September 25, 1939.

This species differs from *M. setifolia* in having acute to acuminate glumes, longer blades, which are not curled below, and a longer panicle; from *M. rigida* in having as a rule a longer and narrower panicle, a shorter, broadly rounded ligule, and longer acute to acuminate glumes, scabrous at the tip; and from *M. dubia* and *M. metcalfei* in having a wider panicle, a shorter ligule, which is rounded instead of somewhat lacerated above, acute glumes, scabrous at the apex, and long-awned lemmas.

TYPE: *L. N. Goodding* M 262, collected in Sycamore Canyon, Ariz., September 22, 1937. The type specimen is deposited in the Soil Conservation Service Herbarium at Tucson, Ariz., with duplicate types in the Rocky Mountain Herbarium, Laramie, Wyo., and in the U. S. National Herbarium.

SPECIMENS REFERRED TO THIS SPECIES: *Silveus* 3477, collected in Sycamore Canyon, Ariz., September 25, 1938; *Silveus* 3489, collected in Box Canyon, Ariz., September 25, 1938; *Goodding* A 9493, collected in Forest Cabin Canyon, Baboquivari Mountains, Ariz., September 24, 1938; *Hardies and Proctor* M 152, collected in Sycamore Canyon, Ariz., November 24, 1936.

Muhlenbergia dubioides C. O. Goodding, sp. nov.

Perennis; culmi dense caespitosi, striati; ligula truncata, 1–2 mm longa; laminae involutae, 15–50 cm longae, 1–2 mm latae; panicula pallida, angusta, 15–35 cm longae, 2–4 cm lata; glumae 2–3 mm longae, acute vel erosae, scabrae ad apex; lemma 3.5–4 mm longum, scabrum; callum hirsutum; arista 3–10 mm longa.

Plants perennial; culms densely tufted, more or less striate, 50–100 cm tall; sheaths rounded; ligule firm to membranaceous, truncate, 1–2 mm long; blades elongate, involute, 15–50 cm long, 1–2 mm wide, scabrous above and glabrous to scaberulous below; panicle 15–35 cm long, 2–4 cm wide, pale, the branches appressed, the lower branches 2–8 cm long, rather densely flowered; pedicels slender, scabrous; spikelets about 4 mm long; glumes membranaceous, 2–3 mm long, subequal, faintly nerved, acute, more or less erose at apex, scaberulous above; lemma 3.5–4 mm long, 3-nerved, scaberulous above and often almost to the base, the callus with tufts of hairs 1–1.5 mm long, the midnerve extending into a rather straight, scabrous awn 3–10 mm long.

This species resembles *M. dubia* in the appearance of the panicle but differs in having a shorter truncate ligule, acute glumes, and a hairy callus. From *M. xerophila* this species may be separated by its narrow contracted panicle, short-awned lemmas, and more truncate ligule.

TYPE: *W. A. Silveus* 3490, collected in Box Canyon, Ariz., September 25, 1936. The type specimen is deposited in the Soil Conservation Service Herbarium in Tucson, Ariz.

Also referred to this species is *E. W. Hardies* and *Ed Morris* M 155, collected in Bear Canyon, Santa Catalina Mountains, Ariz., November 28, 1936.

ZOOLOGY.—*Actiniaria from Alaska and Arctic waters.*[1] OSKAR CARLGREN, Lund, Sweden. (Communicated by WALDO L. SCHMITT.)

Capt. F. E. Lewis, of Balboa, Calif., owner and commander of the M.S. *Stranger*, with the assistance of W. Williams as collector, in the course of his 1937 expedition to the coasts of Alaska and north of Bering Sound obtained an extensive series of marine invertebrates. Included in the material were five species of actinians, which were submitted to me some months ago by the U. S. National Museum for determination. Two of the species seem to be new to science. One of them, *Epiactis polaris*, n. sp., is especially interesting, as it develops its embryos in a circular brood chamber situated in the uppermost part of the body—a type of brood chamber not previously known from Arctic waters but described by me from southern oceans. Because there is a close relationship between the Actiniaria in Bering Sea and the waters of north Japan, I have added here a species of *Edwardsia* dredged in the Sea of Japan in a depth of 2,300 meters, showing that a species of this genus, most of the members of which live in very shallow water, can occur in so great a depth. Finally, I avail myself of the opportunity to comment briefly on some Actiniaria described by Uchida from the coast of Japan.

Family EDWARDSIIDAE

Edwardsia arctica Carlgren Fig. 1

Locality.—Sea of Japan, 41° 38.5′ N., 132° 08′ E., 2,300 m., mud and rubble, temperature at the bottom +0.18°, K. Derjugin, 15.10.1932, 2 specimens.

Discussion.—The specimens were small, sterile, and very badly preserved. The body was so strongly contracted that several tentacles were squeezed out through the aboral part of the body, the invaginated part containing a great deal of detritus, rendering the examination of the animals very difficult. I think, however, that they may be referred to *Edwardsia arctica*. There is nothing about the temperature in which the specimens were taken to refute such a supposition, as it was a little over zero. As a rule, the nemathybomes seemed to contain no nematocysts. By maceration, however, I found some 46–48 by about 4.5μ in size. The nematocysts of the tentacles were 19–24 by 2.5μ, the spirocysts about 12 by 1.5–27 by 5μ. There are probably 16 tentacles. The appearance of the retractors (fig. 1, *a*) and parietal muscles (fig. 1, *b*) of the perfect mesenteries and the distribution of the latter on the column seem to agree fairly well with those in *arctica* (Carlgren, Actiniaria, *The Danish Ingolf Expedition* **9**, 1, fig. 33–38, p. 41. 1921).

[1] Received July 26, 1939.

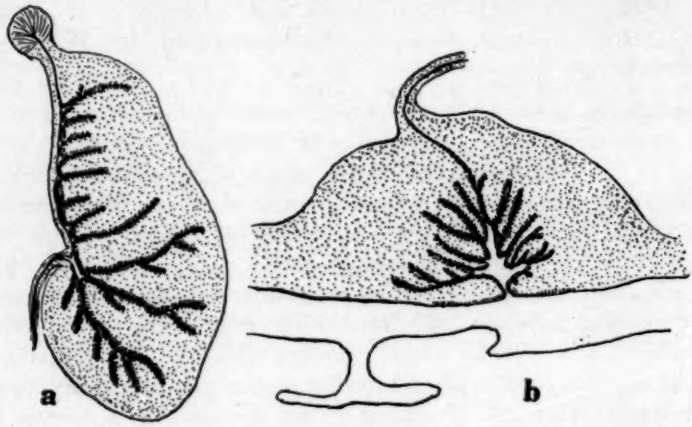

Fig. 1.—*Edwardsia arctica* Carlgren: *a*, Transverse section of retractor; *b*, transverse section of parietal muscle of perfect mesentery.

Family HALCAMPOIDIDAE

Halcampoides purpurea (Shed.)

Locality.—Punuk Island, Bering Sea, 15 fathoms, fine sand, mud, rocks, 15.1.1937, M.S. *Stranger*, W. Williams, several specimens.

Peachia parasitica (Agassiz)

Locality.—Nash Harbor, Nunivak Island, Alaska, rocky gravel, fine sand mud, 20.7.1937, M.S. *Stranger*, W. Williams, 1 specimen.

Discussion.—The fairly strongly contracted, sterile specimen, the length of which was 1.8 cm, the breadth 1.3 cm, had 10 tentacles and 20 mesenteries arranged typically. The conchula was provided with three lobes, one median and cylindrical and two more conical. The nematocysts of the column were 22–29 by 3.5–5μ, often a little curved; those of the tentacles 26–36 by 3.5–5μ, numerous; those of the actinopharynx partly 27–36 by 4.5–5μ, partly 14–17 by 2.5μ; those of the filaments partly 27–35 by 3.5–4μ, partly 36.5–49 by 5–5.5μ, microbasic p-(penicilli-like) mastigophors; the spirocysts up to about 26 by 2.5μ. The color agreed very much with that of *Bicidiopsis tubicola* Verrill. It was pale salmon in alcohol, and the tentacles were provided with four brown cross bands.

Remarks.—*Peachia* (*Siphonactinia*) *parasitica* Agassiz, *Bicidiopsis tubicola* Verrill, *Bicidiopsis arctica* Verrill, and probably *Peachia quinquepunctata* McMurray are, I think, different development stages of one and the same species—a form that reaches a considerable size before it gives up its parasitic mode of life and develops the eight imperfect mesenteries. The different appearance of the conchula is of no great importance, as in *Peachia* the

number of papillae increases with the age of the specimen. Verrill (*Report Canadian Arctic Expedition*, pt. G, p. 125, 1922), proposed the genus *Bicidiopsis* for *Siphonactinia* having 20 mesenteries and a mesogloeal sphincter. This latter statement is certainly incorrect—there was no sphincter in the present specimen. He mentions also that *Bicidiopsis* sometimes had 18 tentacles. If really so, the specimens may have been very abnormal or probably belonged to *Eloactis* or *Haloclava*.

Family BUNODACTIIDAE

Epiactis lewisi, n. sp. Fig. 2

Description.—Body cylindrical, smooth. Fairly close to the sphincter a circular deep invagination forming a brood chamber in the female and containing very large embryos very rich in yolk. Sphincter endodermal, circumscript. Tentacles conical, rather long, probably 24. Longitudinal muscles of the tentacles and radial muscles of the oral disk ectodermal. Actinopharynx longitudinally sulcated. Two well-developed siphonoglyphs. Twelve (6+6) mesenteries, all well developed, perfect, and fertile. Two pairs of directives. Not more mesenteries at the base than at the margin. Retractors of all mesenteries strong, fairly concentrated, those of the mesenteries of the second order, however, weaker than those of the first. Parietobasilar muscles very well developed on a strong offshoot of the mesogloea. Ova very large and rich in yolk. Nematocysts of the column 23.5–26 by 2.5μ; basitrichs, those of the tentacles 29–31 by about 3μ, those of the actinopharynx partly 36–38 by about 4μ, few, partly 26–30 by about 4.5μ, the latter microbasic p-mastigophors, those of the filaments partly 30–34 by 4.5μ, microbasic p-mastigophors, partly 31–38 by about 3μ, partly 14–18 by 2–2.5μ, the latter probably basitrichs.

I have figured the sphincter (fig. 2, *a*) and two mesenteries, one of the first order and one of the second at the level of the lowermost part of the actinopharynx (fig. 2, *c*). Because I did not wish to mutilate the single specimen I had, I have examined closely only two pairs of the mesenteries of the second order. As these pairs were perfect and fertile, there is no reason to suppose that the other mesenteries of the second order should be otherwise constituted.

The brood chamber was formed by a deep circular invagination fairly close to the sphincter. In the bottom of this invagination each embryo lay in a special pocket (fig. 2, *b*). Because of their great size (0.2 by 0.25 cm in diameter), they were rather few in number. The embryos were probably in the gastrula stage. Owing to their poor preservation, I can not decide whether they were ciliated.

Color unknown.

Size in preserved state: Length 2 cm, breadth 1–1.1 cm.

Locality—68° 30′ N., 169° 20′ W., about 30 fathoms, fine gray mud, 7.7. 1937, M.S. *Stranger*, F. E. Lewis, 1 specimen.

Remarks.—The species is closely related to *Epiactis* (*Pseudophellia*) *arctica* (Verrill) and *E. marsupialis* Carlgren, both of which, however, had the brood chamber in the lowest part of the body and more mesenteries at the base.

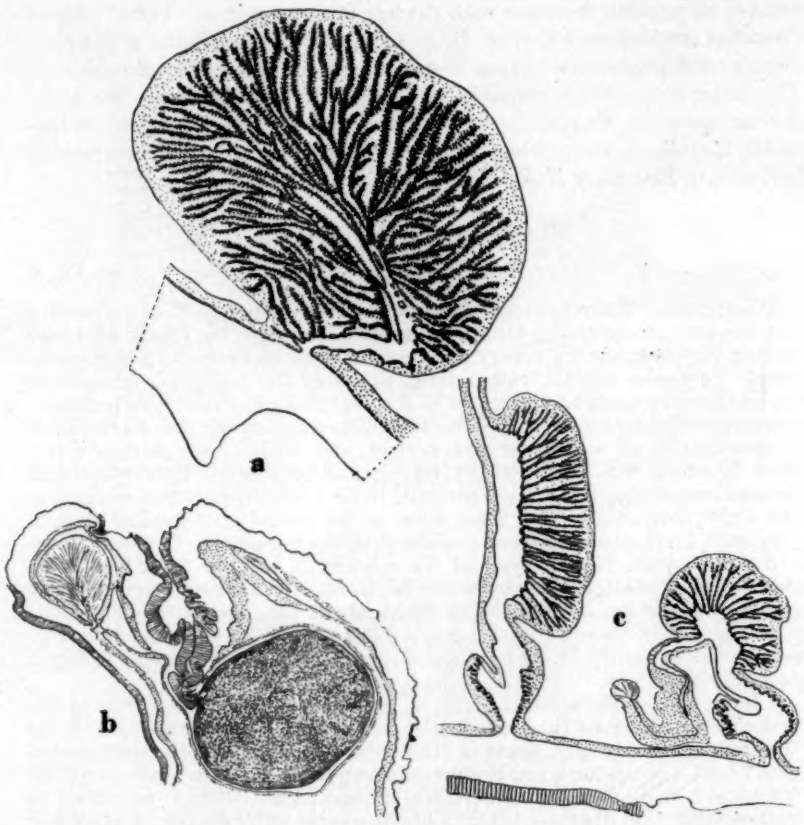

Fig. 2.—*Epiactis lewisi*, n. sp.: *a*, Transverse section of sphincter; *b*, longitudinal section of uppermost part of body, showing sphincter and brood chamber with embryo; *c*, section of one mesentery each of first and second orders at level of lowermost part of actinopharynx.

Cribrinopsis williamsi, n. sp. Figs. 3, 4

Description.—Pedal disk broad, diminishing in breadth upward. Column provided with verrucae in its upper part. Margin with perforated, fairly well developed pseudosphaerules. Fossa deep. Sphincter strong, circumscript, with a rather short main lamella. Tentacles about 48, almost as long as the body, conical, and, at least in somewhat contracted state, almost papillous. Longitudinal muscles of tentacles ectomesogloeal, strong, radial muscles of oral disk mesoectodermal. Two broad siphonoglyphs with well-developed aboral prolongations. Mesenteries more numerous than the tentacles, at the base about 72, two pairs of directives, about 24 pairs perfect. All mesenteries were sterile. Retractors of the mesenteries recalling those of *Epiactis polaris* but weaker, parietobasilar muscles as in this species. Nematocysts of the

column 17–19 by 2–2.5μ, those of the pseudosphaerules 17–22 by 2–2.5μ, those of the tentacles 30–38 by 2.5–3μ, common, those of the actinopharynx partly 34–41 by 4–5μ, partly 27.5–31 by 2.5–3μ, partly 14–19 by about 2.5μ, those of the filaments 24–29 by 4.5–5μ, microbasic p-mastigophors; spirocysts of tentacles about 19 by 2–38 by 4μ.

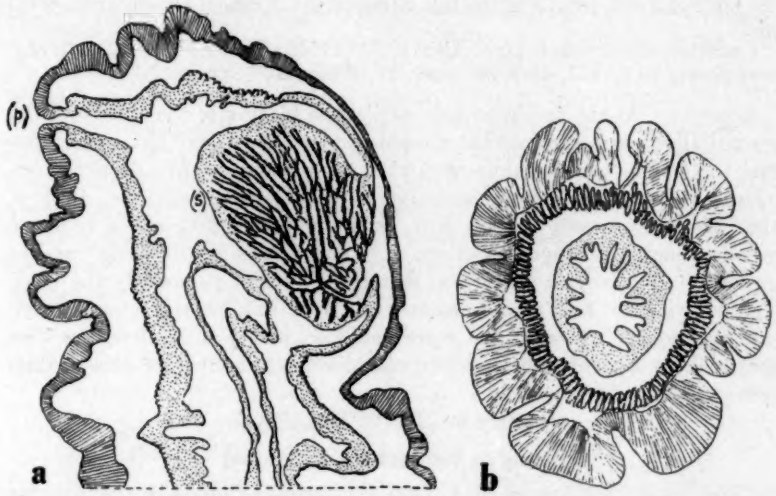

Fig. 3.—*Cribrinopsis williamsi*, n. sp.: *a*, Section of uppermost part of column, showing sphincter (*s*) and one perforated pseudosphaerule (*p*); *b*, cross section of tentacle.

I have reproduced a section of the uppermost part of the column in Fig. 3, *a*, showing the sphincter (*s*) and one perforated pseudosphaerule (*p*). On the left side there is an invagination in the endoderm and mesogloea, indicating the border of a verruca. The pseudosphaerules do not seem to contain more

Fig. 4.—*Cribrinopsis williamsi*, n. sp.: An individual tentacle.

nematocysts than other parts of the column; it was difficult, however, to get good maceration preparations of them. Fig. 4 shows the exterior of a tentacle, Fig. 3, *b* a cross section. The main lamella of the sphincter in other places was sometimes a little stronger, the folds more numerous.

Color unknown.

Size: Breadth of the pedal disk 1.3 cm, at the margin 0.9 cm, height of the body, 1.3 cm, length of the inner tentacles 1.2 cm, of the outer ones 0.5 cm.

Locality.—Humpback Bay, Alaska, 56° 11′ N., 131° 54′ W., 15 fathoms, near shore, 19.8.1937, M.S. *Stranger*, W. Williams, 1 specimen.

Remarks.—As the specimen was sterile, the placing of the species in the genus *Cribrinopsis* is somewhat dubious, but there is no objection to referring the species to this genus except for the presence of pseudosphaerules, which I did not note in my description of *Cribrinopsis similis* (l.c., 1921, p. 156), the only known species. But, as in the genus *Bunodactis*, in which pseudosphaerules sometimes occur, it is not surprising that they may be present in *Cribrinopsis*. In fact, at first I was inclined to identify the specimen with *similis*, but, as the nematocysts were smaller, the tentacles considerably longer, thinner, and more papillose, and pseudosphaerules were present here, I think it is better to consider the present form as a distinct species.

Family ACTINOSTOLIDAE

Stomphia coccinea (O. F. Müller)

Localities.—Off Codbora Bay, Victoria, British Columbia, 10 fathoms, hard bottom, 9.8.1937, M.S. *Stranger*, W. Williams, 2 specimens; Humpback Bay, Alaska, 56° 11′ N., 131° 54′ W., 15 fathoms, near shore, 19.8.1937, M.S. *Stranger*, W. Williams, 1 specimen; Cleveland Passage, Alaska, 57° 33′ N., 133° 30′ W., 12 fathoms, rocky, 16.8.1937, M.S. *Stranger*, W. Williams, 1 specimen; Teller, Alaska, 65° 16′ N., 166° 25′ W., 5 fathoms, mud, some rocks, 11.7.1937, M.S. *Stranger*, W. Williams, 1 specimen; 68° 30′ N., 169° 20′ W., about 30 fathoms, fine gray mud, 7.7.1937, M.S. *Stranger*, F. E. Lewis, 1 specimen.

Most of the specimens were small. As to the determination of the last species I am somewhat uncertain. It is possible that it is a young *Actinostola*.

COMMENTS ON CERTAIN SPECIES OF JAPANESE ACTINIARIA

Uchida (Sci. Rep. Tohuko Imp. Univ. (4), Biol., **13**: 293.1938) refers *Bunodactis stella* to *Anthopleura*, owing to the fact that the figure of this species given by Verrill, 1864, indicates the presence of marginal sphaerules. I have examined many specimens of *stella* from different localities and find no traces of such formations. Verrill also refers the species to *Bunodactis*. Unfortunately, Uchida gives no notes about the nematocysts. The marginal sphaerules proper always are provided with atrichous nematocysts. If atrichs are absent in Uchida's *A. stella*, this species is probably identical with Verrill's form; if the contrary, not. Uchida (l.c., p. 309) set up *Epiactis ritteri*, de-

scribed by Torrey from Alaska, as synonymous with *Epiactis prolifera* Verrill. This is, I think, not correct. The species I called *Cnidopus ritteri* (Torrey), also taken on the coast of Alaska, is very different from *prolifera* and, as far as I can see, is identical with Torrey's species; the nematocyst batteries at the base of *Cnidopus* probably consist of atrichs. It is questionable if Uchida's *Eloactis mazelii* (l.c., p. 288) is identical with the European species. Some other species described by Uchida are not referred to the right genus. *Andwakia hozawai* is probably not *Andwakia*, as it seems to lack tenaculi proper. *Milne-Edwardsia akkeshi* (Annot. Zool. Japon. **13**: 571. 1932) is certainly not *Milne-Edwardsia* but belongs to a new genus, if it is not identical with *Drillactis*, the anatomy of which is unknown. *Phellia decora* (Annot. Zool. Japon. **17**: 623.1938) is not a *Phellia* but a *Telmatactis* (or possibly another genus previously described, see Stephenson, *The British sea anemones*, 1935, and Carlgren, Vet.-Akad. Handl. Stockholm (3) **17**: 67–68.1938). Moreover, it raises the question as to whether the synonyms enumerated by Uchida of *decora* are correct.

ZOOLOGY.—*Notes on the morphology of* Macrostomum ruebushi *var.* schmitti.[1] WAYLAND J. HAYES, Jr., University of Virginia, and FREDERICK F. FERGUSON, College of William and Mary. (Communicated by WALDO L. SCHMITT.)

In October and November 1938, while investigating a pond and its spring source situated beside Charlotte Pike, Nashville, Tenn., one quarter of a mile west of the intersection of Old Hickory Boulevard with the Pike, we discovered what appears to be a new variety of a turbellarian worm, *Macrostomum ruebushi* var. **schmitti.** In this, the type locality, the variety, of which we obtained many specimens and studied about 50 mature individuals, was associated with *Stenostomum virginianum*, *S. tenuicaudatum*, *Dalyellia rossi* var. *tennesseensis*, *Gyratrix hermaphroditus*, and unidentified species of *Provortex* and *Geocentrophora*. The new variety is named in honor of Dr. Waldo L. Schmitt, curator of marine invertebrates, U. S. National Museum, in gratitude for his kind assistance in our work upon Turbellaria. The cotypes are deposited in the U. S. National Museum as no. 20529.

Description.[2]—Sides of the dorsoventrally compressed body subparallel for the greater part of the length of the animal, without lateral indentations in the cephalic region, with slight gradual depressions marking off the spatulate tail; body colorless except for dark eyes and enteric inclusions;

[1] Received September 6, 1939.

[2] The name of this variety was first published in the program of the Seventeenth Annual Meeting of the Virginia Academy of Sciences at Danville, Va., p. 18, May 6, 1939, without description. The characters of the variety were discussed by Mr. Hayes in the paper that he delivered at that time before the Academy. The present account, however, constitutes the first publication of the variety.

total length 1 to 1.7 mm. Epidermis of flattened, usually pentagonal cells bearing an even coat of cilia 10 to 11μ long. Rhabdites, in groups of 1 to 12, distributed over the entire epidermis but most abundantly at the extremities; weak Rhabditenstrassen present anteriorly; Stäbchen abundant, radially arranged about the female gonopore; rhabdites 9.8 to 14μ long, 1.4 to 2.1μ wide; Stäbchen smaller. With groups of sensory hairs 30 to 50μ long and lacking basal spines distributed among the cilia laterally and posteriorly, the lateral hairs stouter than the posterior ones; with semirigid spines 25μ long restricted to the anterior cephalic margin. Paired cerebral ganglia joined by a broad commissure to form a crescent-shaped "brain" located equidistant between the dorsal and ventral sides of the body. Paired eyes approximately 17μ in greatest diameter immediately behind and dorsal to the "brain." Mouth bounded by ciliated lips located ventrally 145 to 190μ from anterior end. Pharyngeal glands directed laterally and then posteriorly, often exhibiting in fixed and stained material large eosinophilic vacuoles bounded by basophilic granules. Enteron saclike, considerably lobed, ciliated, extending dorsally above female gonopore almost to union of vasa deferentia. Excretory system of two laterodorsal main-stems extending almost from one end of the body to the other and connected posterior to the male gonopore by a commissure; main-stems with paired lateral branches including paired end-stems, which, at a level 100 or 130μ behind the anterior end of the enteron, pass mesially and dorsally over the enteron and, coiling, end in paired dorsal openings. Flame cells with flagella about 10μ long. Testes obovate, smooth, located lateroventral and only slightly posterior to anterior end of enteron. Vas deferens extending caudally from each testis to posterior end of enteron and there uniting with its counterpart in entering the vesicula seminalis. False vesicula seminalis not observed. Vesicula seminalis muscular, contractile, thin walled when filled with sperm, thick walled when empty. Entrance from vesicula seminalis to vesicula granulorum guarded by a sphincter. Vesicula granulorum with the proximal portion ciliated, distal portion and the stilette usually filled with granular ma-

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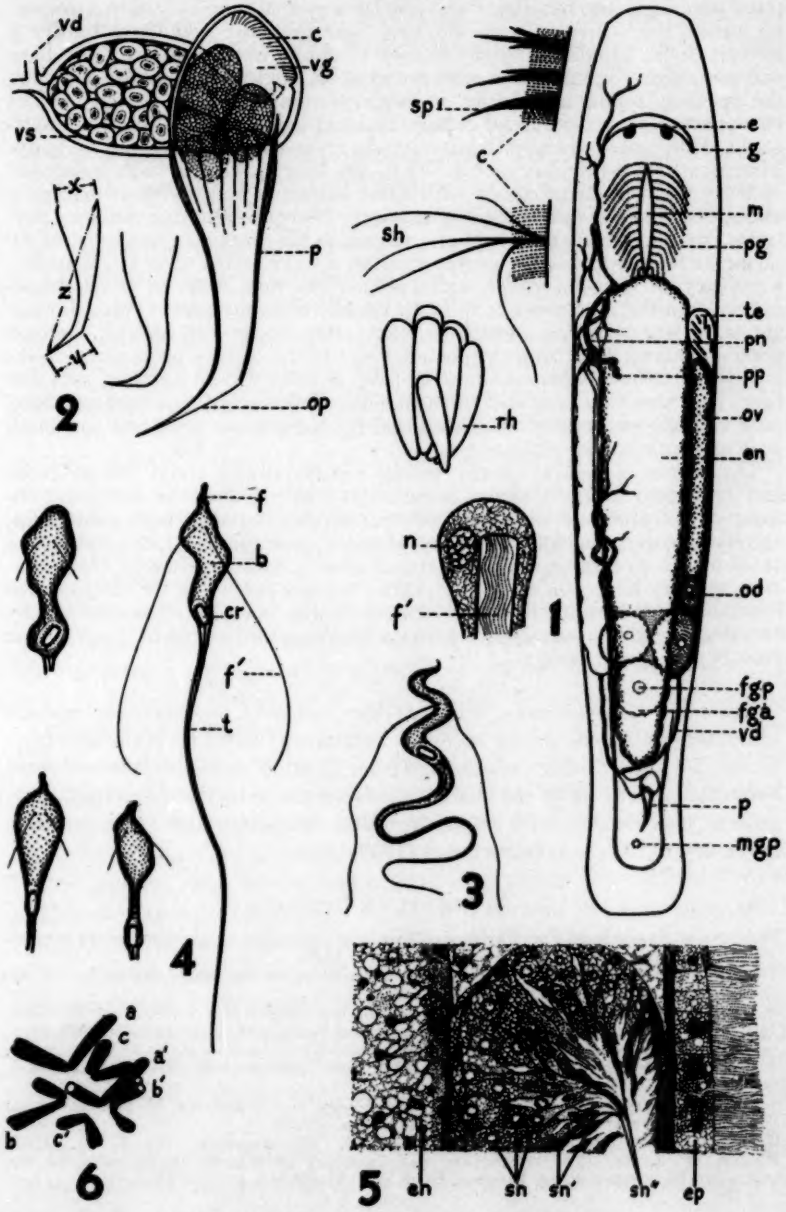
Figs. 1–6.—*Macrostomum ruebushi* var. *schmitti:* 1, Dorsal view of gross anatomy, detail of epidermal spines, detail of sensory hairs, detail of rhabdites, and detail of flame cell; 2, male sex apparatus and two views of penis stilette under varying pressure beneath the cover glass (scheme of measurement: x = base, y = opening, z = total length); 3, normal, living sperm; 4, living sperm swollen by contact with water and three views of the body of the same sperm in different stages of movement; 5, longitudinal section through the testis, showing the condensation of the nucleus during the maturation of the spermatid; 6, somatic metaphase chromosome plate.

ABBREVIATIONS USED

b.....body
c.....cilia
cr.....chromatin granule
e.....eye
en.....enteron
ep.....epidermis
f.....feeler
fga.....female genital atrium
fgp.....female genital pore
fl.....flagellum
g.....ganglion of brain
m.....mouth
mgp.....male gonopore
n.....nucleus
od.....oviduct
op.....opening
ov.....ovary
p.....penis stilette
pg.....pharyngeal glands
pn.....protonephridium
pp.....excretory pore
rh.....rhabdite
sh.....sensory hairs
sn, *sn'*, *sn''*....nucleus in stages of condensation to form chromatin granule
sp.....spine
t.....tail
te.....testis
vd.....vas deferens
vg.....vesicula granulorum
vs.....vesicula seminalis



Figs. 1–6.—(See opposite page for explanation.)

terial organized into bundles. Penis stilette a conical tube housed in a muscular tunic; the cuticular walls thickest near the base and there hardly a micron thick, capable of slight change of shape under pressure; the base widened, highly crenate, the apex flexed at an angle less than 90° and with the opening lacking a distal lip or flange, terminal on the convexity of the curve; average measurement[3] of base 18.5μ, of opening 14.1μ, of total length 62.9μ. Male gonopore approximately 65μ from the posterior end of body. Mature sperm cell highly mobile, 35 to 40μ long, 3.5 to 4μ wide, composed of body and of tail provided with axial filament, body with two flagella about 20μ long extending lateroposteriorly from the anterior portion, posterior portion of body with a single, oblong, in life extremely hyaline granule about 2μ long, which after proper fixation always stains with Heidenhein's hematoxylin, Gentian violet, and Feulgen reaction, none of which treatments stain the remainder of the cell. Female genital system typical for the genus. Ovary about one-fourth as long as the body. Egg grayish. Female gonopore about 200μ from the posterior end of the body. Chromosome number, N = 3, 2N = 6. Chromosomes, as fixed in Allen's B-15 fixative, with one large pair about 3μ long and the centromere submedian, one medium-sized pair with the centromere displaced slightly toward one end, and one small pair with submedian centromere.

Differential diagnosis.—Penis stillette not distally enlarged, the proximal end truncated at right angles to the shaft and crenated, the distal end obliquely truncated and with terminal opening not provided with a distal lip, the shaft with a single flexure of less than 90° near the distal end and with a total length averaging 63μ; pharyngeal glands without striking pigmentation; sensory hairs 50μ or less in length; enteron extending well beyond the female genital atrium; mature sperm 35 to 40μ long and characterized by two flagella and by a single, nuclear-staining granule located in the posterior part of the sperm body.

Remarks.—*Macrostomum ruebushi* var. *schmitti* possesses the specific characters of *Macrostomum ruebushi* Ferguson (1939) but is distinct from the species and its other varieties and from all other species of *Macrostomum* heretofore described by the characters stated above in the differential diagnosis as may be shown by comparing these characters with those set forth in the key to the genus in Ferguson (1939–1940).

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[3] Obtained by the measurement under oil immersion of a dozen mature specimens.

ZOOLOGY.—*Studies on the egg-laying habits of the fairy shrimp.*[1] JOHN LAWRENCE AVERY, George Washington University. (Communicated by D. B. Young.)

During the course of life-history studies on the fairy shrimp *Eubranchipus vernalis*, certain data concerning egg-laying by this form were collected. It is the purpose of this paper to present these data.

In the female shrimp the eggs pass anteriorly through ducts on each side of the body until they come to lie in the brood pouch, which is a conspicuous saclike appendage located on the ventral surface of the female just posterior to the last pair of phyllopods. Located within the brood pouch is a horizontal paddlelike structure, pivoted at the center, which is in continual motion as long as eggs are present in the pouch. Its function is apparently that of keeping the eggs well aerated.

When they first enter the brood pouch the eggs are small, light-gray spheres. After a day or more they become almost twice as large and assume their final light-brown color. At the time of egg-laying, all the mature eggs in the brood pouch are expelled. Of all the shrimps under observation, only one (shrimp 6) expelled small, gray, apparently unfertilized eggs.

All the shrimps used in the experiment were of the same species, *E. vernalis*, and were collected from the same pond. Whenever possible, immature shrimps were selected to ensure the collection of all eggs laid during the life of the individual. Because of the difficulty of obtaining suitable food, large numbers of these young shrimps died before reaching the egg-laying stage. Only those that laid eggs are considered. For comparative purposes, several young mature shrimps were used. The mature and immature were separated on the basis of size, development of the claspers in the male and of the brood pouch in the female, and on general appearance. That these criteria were sufficient was later shown by the fact that within eight days after isolation all shrimps classified as mature had laid eggs.

In practice, one male and one female shrimp of approximately the same size were placed together in a 500-cc beaker containing either filtered pond water or conditioned tap water. Preliminary trials indicated that a temperature of 50°–58° F. was satisfactory for egg-laying. All shrimps were therefore kept within this temperature range.

The eggs, being heavier than water, sink to the bottom of the beaker. Examinations were made at frequent intervals and any eggs

[1] Received September 11, 1939.

TABLE 1.—DATA ON EGG-LAYING BY *Eubranchipus vernalis*

Shrimp No.	Date isolated	Age[1]	First batch		Second batch		Third batch		Fourth batch		Fifth batch		Sixth batch		Total No. of eggs	Average per batch	Date of death
			Date	No.	Date	No.	Date	No.	Date	No.	Date	No.	Date	No.			
11	3/15	M	3/17–18	8	3/24–26	9	3/26–27	24	4/ 7– 8	21	4/11–15	23	4/16–20	10	95	16	4/29
18	3/19	M	3/19–23	9	3/26–27	16	4/ 5– 6	10	4/ 7– 8	11	4/16–20	12			58	11.6	4/29
14	3/14	M	3/17–18	12	3/19–23	16	3/26–27	11	4/ 6– 9	3					42	10.5	4/15
23	2/27	I	4/ 6– 9	16	4/ 9–11	8	4/15–20	6	4/29–30	10					40	10	5/10
31	2/27	I	4/ 6– 9	5	4/11–13	14	4/15–20	12	4/22–26	26					57	14.2	5/15
6	2/27	I	4/11–15	38	4/16–20	7	4/29–30	6[2]							51	17	5/15
13	3/15	M	3/17–18	37	3/19–23	19	3/24–26	6							62	20.6	3/29
15	3/15	M	3/19–23	17	3/24–26	15	4/11–15	4							36	12	4/15
24	2/27	I	4/ 6– 9	14	4/11–15	4	4/16–20	3							21	7	4/20
16	3/15	M	3/17–18	19	3/19–23	13									32	16	3/27
30	3/26	I	4/ 5– 6	17	4/ 9–11	3									20	10	4/15
25	3/19	M	3/24–26	5											5		4/11
28	3/19	I	3/26–27	14											14		4/ 3
29	3/19	I	4/ 1– 2	51											51		4/15

[1] I, immature when collected; M, mature when collected.
[2] Several light-gray apparently unfertilized eggs also found on this date.

found were removed with a pipette and counted. The results are shown in table 1.

These results show definitely that in *E. vernalis* the eggs are not retained in the brood pouch until released by the death and disintergration of the female, as has been reported for some shrimps. Neither have there been any cases observed in which the eggs hatched while retained within the brood pouch.[2] Unsuccessful attempts were made to hatch the eggs immediately after they had been laid. However, the writer has observed eggs laid in March hatch in November.

Six distinct depositions of eggs were laid by one female shrimp (shrimp 11) during the period between March 18 and April 20. An average of three batches of eggs was laid by each of 14 shrimps. The average number of eggs laid by each shrimp was 41.7 with approximately 14 eggs a laying. In the group collected as mature shrimps, females laid an average of 13.75 eggs a batch. In the group collected as immature shrimps the corresponding figure was 14.1. While there was no significant difference in the number of eggs to the batch, the individual shrimps in the group collected as mature specimens produced more batches, resulting in a greater average number of eggs to the individual. The greatest number of eggs laid by a female at one time was 51 (shrimp 29). However, during the spring of 1938 a mature shrimp was collected that laid 118 eggs during a 24-hour period. Another shrimp collected during the same season laid 165 eggs in two batches over a 5-day period. Such variations are probably caused by environmental factors.

[2] MORGAN, A. H. *Field book of ponds and streams.* 448 pp. 1930. Putnam's, New York.

ORNITHOLOGY.—*The starling's family life and behaviors.*[1] H. A. ALLARD, Washington, D. C.

In many parts of the United States and Canada the introduced starling (*Sturnus vulgaris*) has become one of our most familiar and abundant birds. While it is generally conceded that this bird is highly versatile and adaptive in its behavior, there is much to learn considering the daily activities of its summer family life, and the various manifestations of its gregarious life throughout the wintertime.

In February, 1929, the writer erected at the end of his barn an observation box, so constructed with a glass top in a darkened attic that one could at all times observe intimately every behavior of the parent birds and the young within, since the eyes of the observer were brought within 7–8 inches of the nest. This box was furnished with an entrance hole slightly over 1¾ inches in diameter, to admit the starlings readily. This is a matter of some importance since starlings can not pass a hole 1½ inches in diameter, which is sufficiently large for the entrance of bluebirds.

The following account is based mainly upon behaviors revealed by a pair of starlings which appropriated this observation box.

THE NEST

The starling is primarily a cavity-nesting bird. Old previously used nesting sites are preempted usually by the same pair of starlings throughout the season. Even throughout the wintertime the parent birds hold their respective boxes and, when not engaged in hunting food, spend the hours from dawn till dark fighting off meddlesome intruders of their kind, all the while indulging in their usual native loquacity and varied mimicry.

In February and March, or even in January, the starlings renew their nesting activities with an attendant increase in the power and variety of their vocal mimicry and expressions. They begin a very active inspection of the boxes and carry out and discard much of the old nesting material.

The new, clean observation box erected for them was quickly appropriated, and nest building began in March. Material, including mostly straw and grass stems, together with a few feathers, was very leisurely carried in by both sexes.

From the outset, the site of the nest depression itself was indicated

[1] Received October 26, 1939.

by a circular space bare to the bottom of the box, which elsewhere was covered about an inch deep with a mat mostly of dead grass stems and leaves. The circular space remained bare, neatly and carefully surrounded by the nest foundation, which was built up around it. As this mat became deeper, the depression itself finally received a layer of fine grasses and some feathers, to constitute the final nest hollow destined for the reception of the eggs.

From time to time both birds added an occasional straw or feather to the nest even long after the young had appeared. Occasionally a green leaf was brought in, a behavior that is indulged in by a number of birds, more especially by the larger birds of prey, but the purpose of this green material is not well understood.

Throughout all the procedure of nest-building the male worked as diligently and as devotedly as the female, for the starling's home activities involve an unfailing cooperation between the sexes at all times.

INCUBATION AND BROODING

Five eggs were laid, but the exact dates of laying were not determined. Following laying the male was quite as punctilious and faithful in the incubation of the eggs as the female.

The carrying of food to the brooding parent by its mate was never observed at any time. This would seem quite unnecessary since both parents share equally in the work of incubation and brooding. When one leaves the nest the other is usually entering and at once takes its place.

Frequently one or the other parent has arrived at the box entrance and expressed its desire to enter with food. The bird within, however, maintains its claim to the nest and not even its mate can enter until it has left.

On April 21 four of the five eggs had hatched, one delaying hatching until April 22, and this belated bird was destined by these fateful circumstances to become the runt of the family.

While the fledglings were very young and helpless the mother starling, alone, brooded them at night. The male was never seen to do this, although during the day he was quite as solicitous of the family and did his full share of brooding at every opportunity. While the birds were very tiny and naked and temperatures were low, the brooding impulse was much more persistently shown. Later, as the young birds became larger and covered with feathers, they were left at night.

When brooding took place, the parent bird settled down over the

young, always with the same characteristic procedure. This is done with a gentle sidewise wiggle into the final rest position. It would appear that this allows a better adjustment of the little birds to the parent's body, and is practiced by both male and the female.

FEEDING THE YOUNG

As previously stated, four eggs were hatched on April 21, and one on April 22. The young remained in the nest just 21 days. During this period development was rapid, from tiny, naked, blind, tottering mites of life to practically fully grown and feathered adults. This necessitated continuously changing adjustments on the part of the parents in supplying food to the young, in the sanitation of the nest, in brooding, etc.

Feeding began at once, both birds bringing in tiny caterpillars and other insects usually one at a time. These were usually crushed or macerated and very deftly and always very gently tucked into the tiny gaping throats. It was obvious that the parents seemed to realize that the tiny nestlings were in a helpless stage and required very dainty and gentle handling.

As the birds increased in size, there was a noticeable increase not only in the size of the caterpillars and spiders brought to them, but these were gathered by beakfuls, not singly as before. This change in the manner of feeding came about rather suddenly after the young birds were 6–7 days old. There was also a marked change in the manner of feeding, the very gentle profferings of the first few days giving place to more hurried and less solicitous jabs down the throats of the growing birds. There was of necessity a very evident speeding up of the entire round of family attention, involving more frequent visits with food, larger beakfuls, larger insect material, until finally, when the birds were half grown, hard-shelled June beetles, mulberries, and other bulky material were fed in a very impetuous manner.

Even after the young birds are fully grown and have left the nest, the starling families do not appear to disintegrate for some time. Although the young birds are well able to glean their own food, they may frequently be seen following the hard-worked parents around beseeching food. At such times it is not unusual to see the parents feeding them in the trees or on the lawns.

NEST SANITATION

It is obvious that where there are helpless young birds some degree of sanitation must be practiced so long as they remain in the nest.

This apparently becomes one of the great problems of the starling in the restricted room of their boxes and cavities. However, they make every effort to keep their young in a cleanly condition, and as the young themselves become older, they, too, become imbued with a sanitation impulse, which expresses itself in movements to or beyond the rim of the nest to deposit their excrement. The extent to which nest sanitation succeeds depends upon many factors, such as the industry of the parents, their mutual cooperation, the size of the nest box, the character of the food, the season of the year, temperature, etc. In very small crowded quarters, nest sanitation becomes much more difficult than in an airy, roomy box such as the writer's observation box.

Fecal deposition began as soon as feeding took place, and as the alimentary canal became filled the act almost regularly followed the feeding reaction. Both parents carried the fecal matter away, searching very circumspectly among the young for such material, picking up even the smallest particles. On a very few occasions this excrement was eaten, but this seems to be a very unusual behavior on the part of the starlings. The parents seemed to be quickly aware of fecal deposition and even appeared to watch a suspicious bird in the expectancy of this act, oftentimes, after each feeding.

Throughout the entire day, food was brought in usually with every visit, and excrement carried out on leaving. Only rarely did a parent bird enter without food or leave without fecal material. It was interesting to observe that when a parent bird brooded, it was instantly aware of the deposition of feces beneath it, probably from the feel of this extrusion upon its feet at times, and straightway it looked beneath and bore it away, to return quickly with food.

The starlings are early risers, and when the female had remained in the box at night to brood the very young birds, she left them at very early dawn even before it was light enough for her to seek food. However, during this pre-feeding period she busied herself industriously by carrying out fecal matter that had been deposited during darkness. Likewise in the evening, when the dusk had put an end to feeding operations, both birds continued to carry out fecal material so long as they could see.

At first the young were too weak and helpless to do more than defecate in the nest. Within four or five days from hatching, however, they began to evince a tendency toward nest sanitation of their own initiative. The young birds were making efforts to reach the side of the nest and scrambled over one another to take this position. After

the sixth day many depositions took place at the very edge of the nest, and very soon these were placed beyond and well away from the nest rim. This tendency finally became an impelling mood, and near the beginning of the third week of their existence the young had established a defecating zone far beyond the nest and toward the opening of the box. This is shown in Fig. 1. The actual factors that

Fig. 1.—Sketch showing the deposition of the feces in a well-marked fecal zone outside the starling's nest at the beginning of the second week of existence by the young nestlings. It is evident that attention to personal cleanliness and nest sanitation has arisen in the behavior of the young birds in the course of their rapid development. With the strength and control of the muscular system has come a conscious or subconscious psychic manifestation of sanitation, working most admirably in the direction of comfort and economy of the family association.

determined the location of this zone are not known, but there is strong reason to believe that orientation was associated with the entrance hole and was dependent upon light or temperature conditions or both. Whatever the correct explanation, it is obvious that the young themselves, as soon as they were able, were governed by a sanitation impulse, and the adoption of this fecal zone greatly simplified the labors of the parents and resulted in better nest sanitation.

MAKING THE BED

From the time the young appeared, and until they had become almost independent of the nest, the parent birds concerned them-

selves very much with the making up of the nest, as it seemed. This operation was performed with equal attentiveness by both parents. The parent stood astride the nestlings or among them and jabbed its beak everywhere deep down beneath their frail little bodies, evidently poking holes into the consolidated mat, perhaps to aerate it or to hasten drying. Whatever this procedure meant to them it was done very frequently and thoroughly and with such vim that one wondered how the tiny nestlings escaped being injured at times.

This shaking up of the bed was also performed by the brooding mother during the night, when she remained with the young for the first few days after they had appeared. Oftentimes at dawn when she finally left the box to feed or to seek food for the young, it was evident that the nest had been entirely remade during the night. This was shown by an obvious deepening of the nest bed and a bringing in of new and clean straw material and feathers from the mat within reach.

As one or the other of the parents has taken its position over the young birds to brood them, it has more than once been seen to reach out and seize a straw and poke it beneath its body. At other times it has picked up a loose feather and dropped it over its body so that it fell loosely over the head or body. Such material probably sooner or later falls into the nest and constitutes a new and clean lining.

REACTIONS TO EXTRANEOUS MATERIAL INTRODUCED INTO THE BOX

During the writer's study of the starlings' family life, various experiments were carried out. When the parents had gone, a great variety of material was dropped into the box, including pieces of flowers, green leaves, green shoots, bits of banana, fragments of paper, chewed wads of paper, wood shavings, prune seeds, and such animal material as May beetles, snails in the shell, cutworms, chrysalids, and angleworms, all of which had been immobilized by crushing to prevent their escape. Likewise small strawberries were dropped into the box. Much of this constituted the normal material fed to half-grown birds.

The green leaves were scrutinized critically but were usually allowed to remain, together with such material as small pieces of paper and dry wood shavings. All other material, of whatever nature, including May beetles, strawberries, etc., even though constituting the natural food when brought in by the parents, was unhesitatingly discarded. Such material as paper, bits of leaf material, etc., that

could be incorporated into the nest appeared to pass as nest material and was allowed to remain. Food substances of whatever nature, however, appeared to fall into the category of waste material comparable to fecal matter and were usually very promptly discarded.

Strangely enough, if the parent bird dropped an insect morsel while attempting to feed a young bird, it invariably picked this up and offered it again. On the contrary, insect material found in the box or nest was never directly fed. In one instance a roach dropped into the box was quickly carried out by the returning male, and when he reappeared he offered a ground roach to the young. Whether this was the same roach previously dropped into the box can not be established, as these insects were sometimes brought to the young.

The placental structure of a large green pepper with the seed attached was dropped into the box in the absence of the parents. This object was nearly as large as the entire dimensional size of the young. It was casually inspected by the first bird to enter the box but was untouched. However, when accidentally knocked into the nest by one of the parents returning later with food, it was finally carried out of the box, but not without some effort owing to its weight and bulkiness.

SOCIAL RELATIONSHIPS

The starlings at all times are more or less gregarious in their relations. Even when the family burdens of the summertime break up their great winter aggregations, they remain friendly to one another and never entirely lose the helpful social spirit. Unlike many other more individualistic and independent birds, they appear to evince no definite territorial claims and forage and feed wherever they choose, oftentimes together.

The starling is very largely a ground feeder. As it scrutinizes the grass and ground debris it has a very characteristic habit, peculiar also to the grackle and perhaps to various other blackbirds. As it thrusts its beak into the grass and ground debris, it spreads the mandibles apart with every thrust, either to enlarge the hole its beak has made or perhaps to feel with its tongue. Whatever the purpose of this behavior it is an invariable racial trait. The starling never scratches in the ground debris as do the chewink and many sparrows and never tosses the loose debris about with its beak as does the brown thrasher.

Although the starling is preeminently a ground feeder, preferring lawns and open fields for its foraging, it is inordinately fond of mul-

berries and very readily distinguishes the ripe black fruits from the red green ones. To this degree its color sense is highly developed.

In the wintertime when the gregarious mood has reached its height, the flocking impulse is a marked feature of all its behaviors. It flies from its city rendezvous to the country to feed by day, and returns in the evening, often aggregated into enormous flocks, whose precise and synchronized maneuverings are marvelous to behold.

In the wintertime the starlings are wont to feed in similar formations, which move very systematically over a field as the birds walk along. However, with their keen insight those in the rear of the formation realize that the new territory just ahead of the advancing front line is likely to afford the choicest morsels. These then constantly arise and fly ahead and descend to become in their turn briefly the front line, for they too, will soon be replaced by others flying up from the rear. Thus the foraging flock moves along smoothly, partly by walking and partly by flight, enabling all the members to have their chance in the scrutiny of new ground, which otherwise would be denied those always remaining in the rear.

The starlings cling very tenaciously to the boxes and nesting sites they have preempted and will fight almost to the death any interlopers of their own kind, or even other birds. The writer once found a pair of females locked so tightly together by beak and claw, as the result of a combat, that both birds lay helpless in the box, and when picked up could only be disengaged with much effort. How long they had lain thus is not known.

In the writer's trees the flickers fought bravely to oust starlings from their boxes, but they were no match for their smaller and more agile adversaries. On several occasions a flicker struck at a starling with great force, but his blows were too slow and deliberate to reach his more active enemy. On several occasions the starlings showed tendencies to gang up against the larger bird and were frequently seen to cling tenaciously to their feathers in their attacks.

The story was entirely different with the little screech owls that nested next door to the starlings. The latter never ventured into the owls' quarters, although on several occasions the little owls at dusk were seen peeping into the starlings' homes. In spite of their hatred of the owls, both birds carried on their economies in close proximity, but it was plainly obvious that the starlings merely accepted the inevitable quietly, since there was nothing else to do.

Occasionally a small hawk appeared; then the starlings became

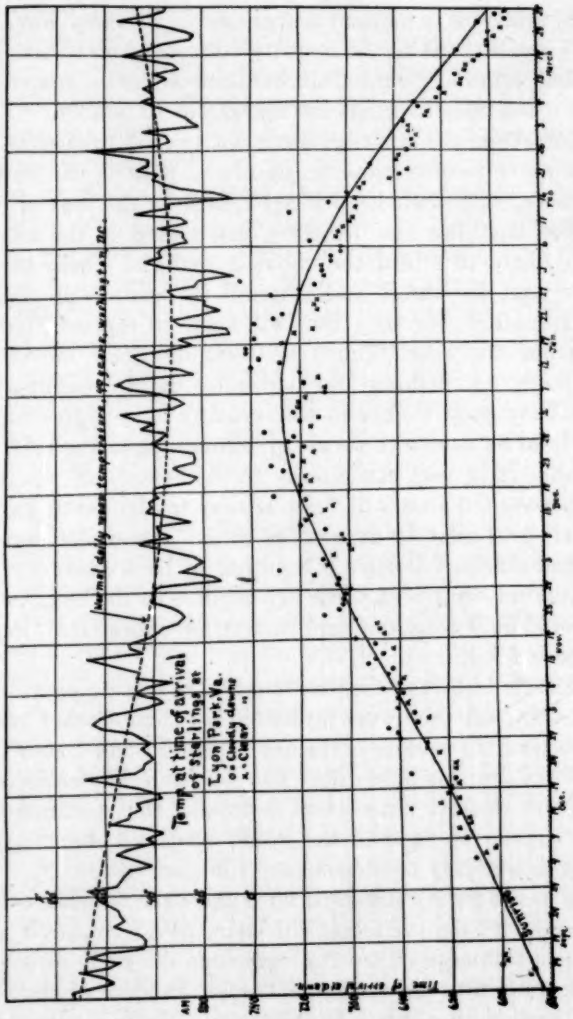
Normal daily mean temperature, Washington, D.C.
Temp at time of arrival of Starlings at Lyon Park, Va.
o = Cloudy dawns
x = Clear "
Sunrise
Time of arrival at dawn

Fig. 2.—Time of dawn arrival of the starlings at Lyon Park, Va. 1929–30, in relation to the sunrise curve (E.S.T.) and temperature at time of arrival. Broken line shows the normal daily mean temperature at Washington, D. C., for 49 years.

alert and even gathered into bands and flew about ready to persecute it with their disconcerting maneuverings.

During the summer when the female remained with the tiny young at night, the males appeared to roost nearby in pine trees. Later when neither parent remained with the young birds, the males and females appeared to repair to their respective roosts somewhere near at hand. In autumn, when the flocking urge is at its height, both parents, apparently still mates throughout the winter season, fly to and from the city where they spend their nights.

The time of leaving the nesting box at night and of the arrival at dawn depends upon the factor of light intensity, and these curves follow closely the curves for the seasonal time of sunrise and sunset (Figs. 2–4). During the winter season, however, those light intensities that send the birds to roost are far higher than those that drive them to roost in summertime, as if they were very loath to leave their young. It is highly probable here, however, that we have marked seasonal differences in physiological sensitivity of the eye to light, owing to the very different hormonal organization expressing itself at the two seasons.

DISCUSSION

We have followed some of the more striking behaviors of a family of starlings from the time of nest building to the maturity of the young birds and the final abandonment of the nest by these exactly 21–22 days from the hatching of the eggs. It is evident that there are many outstanding behaviors in the starlings' life history concerned with nesting, incubation, feeding, and sanitation that are of much interest.

In the first place, a remarkably close cooperation between the male and the female obtains in all the essential activities connected with the preparation for and the raising of the family.

The male aids in nest building, incubates the eggs, feeds the young, and attends to the cleanliness of the nest with as much interest and punctiliousness as does the female. There appears to be one phase of duty, however, that he does not normally assume. The female, alone, appears to remain with the tiny, helpless young for the first few nights of their existence.

The writer has heard it stated that starlings are filthy birds, but this can not apply indiscriminately to all starling parents. It is probably nearer the truth to say that starlings do their best to maintain clean nests for their families.

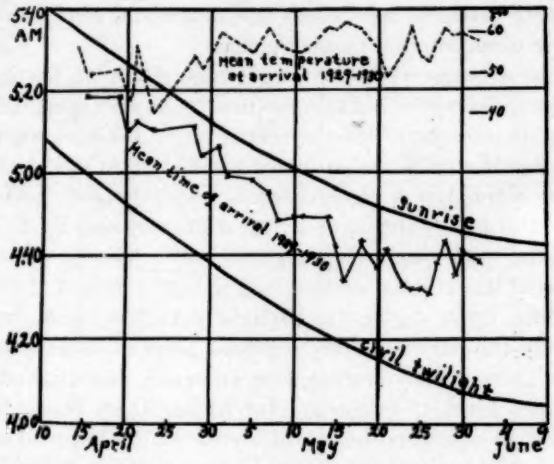

Fig. 3.—Mean time of arrival of the starlings at Lyon Park, Va., derived from the data of 1929 and 1930. The two-year temperature mean at the time of arrival is also shown. The correlation between sunrise and the two-year mean for the first arrival for the years 1929–30 as obtained was 0.962 ± 0.009. The correlation between the two-year mean of first arrival and the two-year temperature mean was found to be -0.482 ± 10.

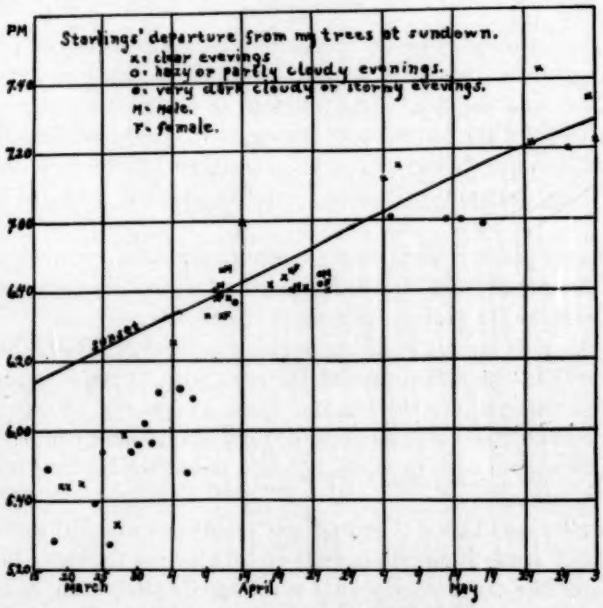

Fig. 4.—Departure of the starlings from trees of the writer at Lyon Park, Va., at sundown, 1930, in relation to sunset (E.S.T.).

Should one or the other parent die, there is every reason to believe that the remaining parent would assume the care of the family to the best of its abilities. In such an event it is probable that the usual degree of cleanliness of the nest could not be so successfully maintained as when two conscientious mates were working industriously toward the same end.

Nest sanitation is a real necessity for the health and comfort of the young birds, and many factors must modify the degree of success attained, one of no small importance being the roominess of the cavity holding the nest.

It is obvious that the young themselves very soon evince tendencies toward cleanly habits, which has finally expressed itself in the adoption of a definite fecal zone entirely without the nest. We have, here, the foreshadowing of the localized or latrine concept, which some animals have evolved to a high degree.

Where sanitary conditions have not been maintained, for one reason or another, conditions may become so filthy as to cause the death of the young birds. In one instance a young bird that had left its nest nearby was scarcely able to use its legs from the enormous thickness of the excrement dried and accumulated upon them. It required much effort and washing to free this bird of its filth, and it would probably have died had it remained in its befouled condition. It is not known what causes were responsible for this.

It has not been determined whether unattached birds—one may call them widows, spinsters, or bachelors—ever enter into the care of a starling family, where one or both parents die. It seems probable that this may occur, however, for on several occasions when the legimitate parents of the family under observation were away, strange starlings have occasionally appeared at the box entrance to peep in curiously. These are quickly driven away when the parents arrive.

One of the most striking features of starling behavior is the rigid observance of carrying out all introduced material, food or otherwise, that has been dropped into the box. It would appear that all extraneous matter not brought in by the parents themselves, even though it may be acceptable food, is treated as if it belonged in the category of excrementitious material.

Some biologists would explain all the niceties of adjustment and accomplishment we have observed as an example of a train of mechanized integrated behaviors from which there was no escape. The writer feels that we can not talk too dogmatically on this point. At times there seems to be some element of experienced judgment in

operation as much as anything else. It is obvious that rarely has there been any useless, accidental behavior shown, all behaviors operating smoothly, rapidly and progressively to meet in a timely manner, all the needs and adjustments demanded by a rapidly changing developmental cycle.

The writer does not feel qualified at the present time to say what moods in these behaviors are consciously reasoned and what are purely mechanical, to be dogmatically referred to reflexes, tropisms, or whatnot. Even we, in our highly civilized moods, at times show many instances of mechanized, stereotyped behaviors that have no longer logical meaning for the situation, as when we cling to archaic procedures simply because they are sanctioned by custom or habit or had become legal usage long ago.

A study of the starlings' behavior and family life indicates a very high order of bird intelligence throughout and a close attention to all phases of the family welfare. It is evident that the intimate understanding and cooperation of the two parents in all the stages of preparation for and the care of the family have helped to make the starlings highly adaptive and successful birds wherever conditions are favorable for their survival.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

COMMITTEE ON CATALOGING SCIENTIFIC SOCIETIES OF WASHINGTON AND DEFINING QUALIFICATIONS FOR AFFILIATION

As its meeting on November 10, 1939, the Board of Managers received and accepted a report from a committee, consisting of C. P. CLAUSEN, F. M. DEFANDORF, W. D. LAMBERT, J. E. MCMURTREY, JR., and W. T. SCHALLER (chairman), dealing with the cataloging of the scientific societies of Washington and the definition of the qualifications of a society for affiliation with the Academy.

To be eligible for affiliation the given scientific society, association, or club must be concerned with natural science, with the social, economic, or historical sciences, or with any phase of engineering; must hold its meetings within an area that includes the District of Columbia and the territory lying within 25 miles of it; must have a membership of whom the majority reside within the area indicated; must have a regularly constituted organization with elected officers; must concern itself primarily with the search for facts and truths rather than with the popularization or commercial exploitation of them; and must have at least an effective nucleus of members actively engaged in pure or applied scientific research who control the policies of the society.

The list of scientific societies, associations, and clubs reported by the present committee, which completed work begun by an earlier committee of the

Academy, includes (1) regularly organized bodies that hold their meetings within the District of Columbia or the territory lying within 25 miles of it, (2) local sections of national societies and associations, (3) national societies that have their headquarters in the indicated area, and (4) scientific organizations affiliated with universities and colleges in the given area. The list is printed here with a request that readers will please notify the editors of the JOURNAL of appropriate corrections or additions:

Academy of Medicine of Washington
Agricultural History Society
American Anthropological Association
American Association for the Advancement of Science
American Ceramic Society, Baltimore-Washington Section
American Chemical Society
American Engineering Council
American Fisheries Society
American Forestry Association
American Genetic Association
American Geophysical Union
American Horticultural Society
American Institute of Architects
*American Institute of Electrical Engineers, Washington Section (1912)
American Institute of Mining and Metallurgical Engineers, Washington Section
American Iris Society
American Nature Association
American Orchid Association
American Ornithologists' Union
American Pharmaceutical Association
American Phytopathological Society
American Society of Agricultural Engineers, Washington Section
American Society of Civil Engineers, District of Columbia Section
American Society of Heating and Ventilating Engineers, Washington Section
*American Society of Mechanical Engineers, Washington Section (1923)
American Society of Metals, Washington Chapter
American Society of Naval Engineers
American Statistical Association
American Therapeutic Society
American Welding Society
*Anthropological Society of Washington (1898)
*Archaeological Society of Washington (1902)
Association of Military Surgeons of the United States
Association of Official Agricultural Chemists
Baird Ornithological Club
*Biological Society of Washington (1898)
*Botanical Society of Washington (1902)
Catholic Anthropological Conference
*Chemical Society of Washington (Section of the American Chemical Society) (1898)
Chemists' Club (Georgetown University)
Colorists, The
*Columbia Historical Society (1899)

* Affiliated with the Academy. Date indicates year of affiliation.

District of Columbia Dental Society
District of Columbia Homeopathic Medical Society
District of Columbia Optometric Society
*Entomological Society of Washington (1898)
Genetic Club, The
*Geological Society of Washington (1898)
*Helminthological Society of Washington (1923)
History of Science Society
Horological Institute of America, Inc.
Insecticide Society of Washington, The
*Institute of Radio Engineers (1933)
Maryland State Horticultural Society
*Medical Society of the District of Columbia (1898)
Metropolitan Section of Model Engineers, Inc.
National Academy of Sciences
National Aeronautic Association of the United States of America
*National Geographic Society (1898)
Paleontological Society of Washington
Patent Office Society
Petrologists' Club of Washington
*Philosophical Society of Washington (1898)
Pick and Hammer Club
Society for Experimental Biology and Medicine
Society for Philosophical Inquiry of Washington
*Society of American Bacteriologists, Washington Branch (1923)
*Society of American Foresters, Washington Section (1904)
*Society of American Military Engineers (1927)
Society of Automotive Engineers, Inc., Washington Chapter
Society of Woman Geographers
Washington-Baltimore Psychoanalytic Association
Washington Biologists Field Club
Washington Camera Council
*Washington Society of Engineers (1907)
Wild Flower Preservation Society
William Beaumont Medical Society (George Washington University)

COMMITTEE ON CERTIFICATE OF AWARD

The Committee on the Certificate of Award of the Academy, consisting of H. B. HUMPHREY (chairman), B. Y. MORRISON, and R. E. SNODGRASS, reported to the Board of Managers on December 1, 1939, concerning a suitable certificate of award to be granted to the recipients of the scientific awards recently established by the Academy. The committee was instructed to proceed with the provision of the certificates.